The Engineering and Mining Journal

Volume 101, No. 16
Issued Every Saturday
Hill Publishing Company

NEW YORK, APRIL 15, 1916

Price, 15 Cents
Contents, First Page
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PERIODICAL ROOM
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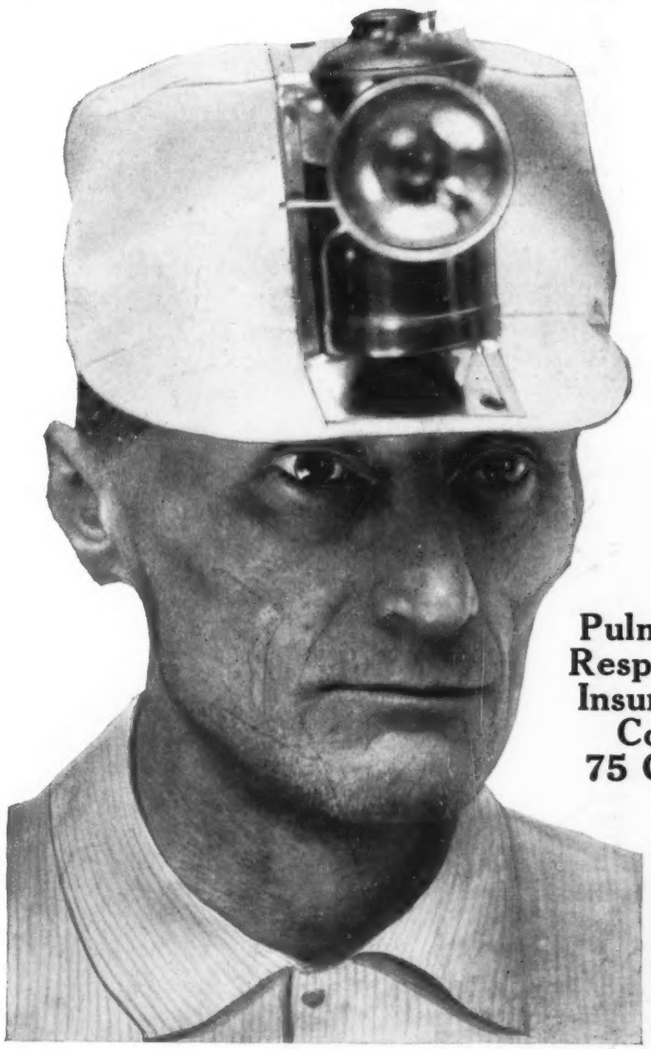
Which Man Would You Rather Carry on Your Payroll?



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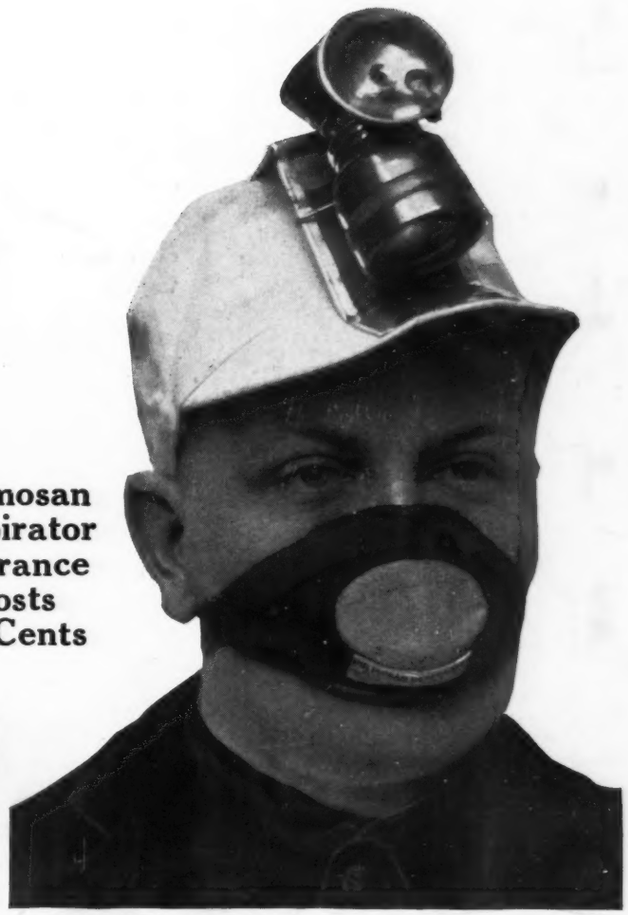

This Man has tuberculosis. Breathing rock dust made him the hopeless wreck he is today. He is a handicap to himself, an obstacle to his fellow workers and an expense to his employer. With free access to his lungs, the deadly particles of rock dust have gotten in their work. The man is a weakling, and his condition is progressive. He is shot to pieces.

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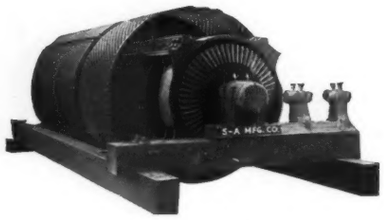

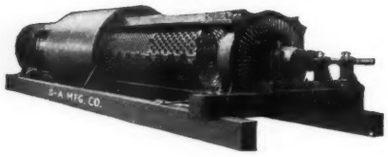

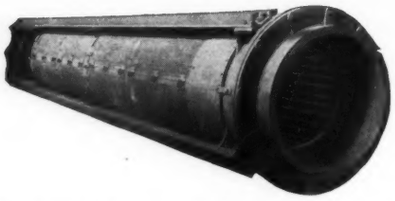

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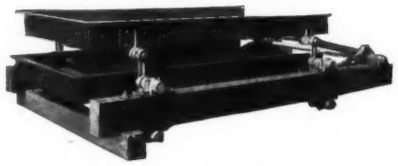
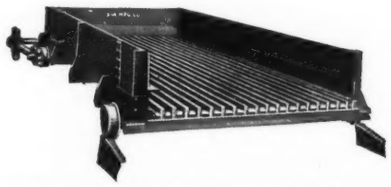
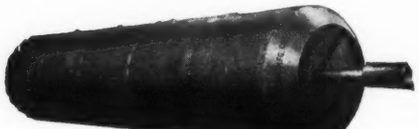


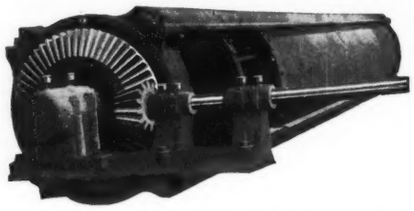
Double Rocker arranged in balance



Combination Shaking Screen and Feeder.



This revolving screen is for coal service, etc.



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Mining Journal

VOLUME 101 APRIL 15, 1916 NUMBER 16

Dredging in Mozambique

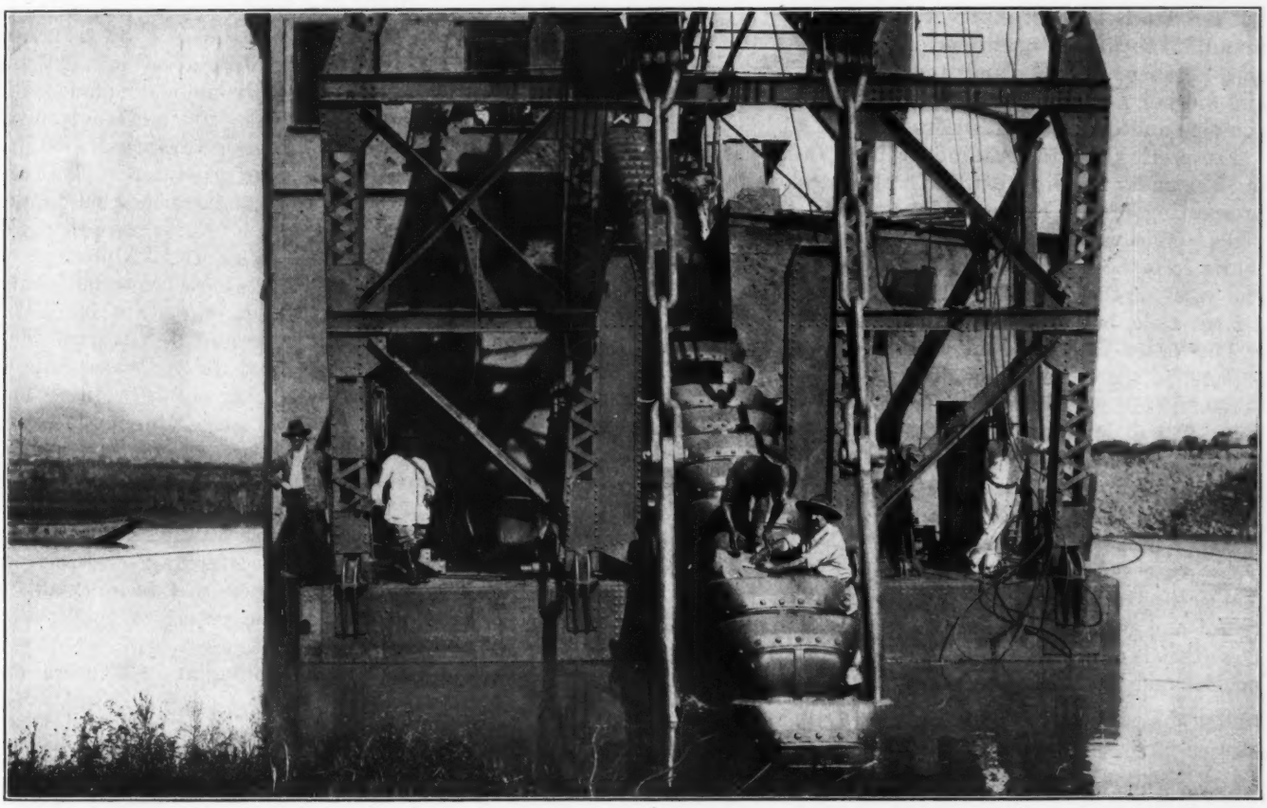
By L. C. de la Marliere*

SYNOPSIS—A dredge that works profitably the low-grade gravels of a territory in Mozambique. Boulders are blasted in the dredge buckets without damaging them, a practice that has been followed for years.

The province of Manica is in the western part of Mozambique territory, near the Rhodesian border. The principal town of the district is Macequece, through which the railway from Beira to Umtali-Salisbury-Bulawayo passes, and is at an elevation of 1,500 ft. The seasons are divided into rainy and dry, the latter usually lasting eight months, from May to December, four of which are cool and the others warm. From December to May high temperatures prevail, heavy rainfalls soak the ground and there is danger of fever, though the climate is not unbearable if hygienic precautions are taken. Mozambique is the Portuguese East African possession.

Manica province is traversed by a gold-bearing schist belt running from east to west and including several gold-quartz mines. The axes of the schist belt are formed in Manica by the Revue valley, and in the adjoining Rhodesian teritory by the Umtali River. Entirely surrounding the schist-belt the country is granite. The accompanying sketch map gives an idea of the general district.

Many gold-quartz veins exist in Manica, but the Braganza lease has been developed only lately by the Andrada Mines, Ltd. The alluvial deposits have been of greater interest up to the present time and have been worked since prehistoric days. It is even asserted that the gold of the Queen of Sheba came from Manica and Rhodesia. Whatever the truth of this statement, however, it is certain that large and important workings have been carried on by the natives, usually under the armed supervision of the Portuguese when the latter first occupied the territory in the Sixteenth Century. These workings consist of vertical shafts uniting underground explorations and

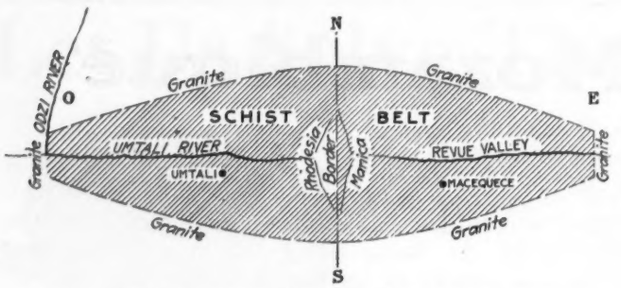


PLACING DYNAMITE FOR BLASTING A BOULDER IN THE DREDGE BUCKET

*Director, Andrada Mines, Ltd., Macequece, Mozambique.

some drifting work. In recent times experimental work has been carried out by English and Portuguese operators with sluices and washing boxes, but all this work was commercially unsuccessful and gave rather a bad reputation to the deposits.

About twenty years ago, a dredging company started to operate with a small, 3-cu.ft. dredge of the Australian

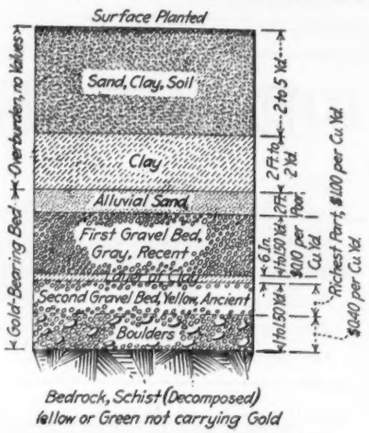


THE MOZAMBIQUE PLACER AREA

type, on a deposit in the Mudzoi, a tributary of the Revue. After working for only about eight days, the company was bankrupt and the dredge was abandoned. Prospectors have been unable to find payable parts in this deposit because the water is so abundant in the ground that they did not reach bedrock, upon which 75% of the gold is found. The dredge operators did not notice the difference between New Zealand and South African ground and did not recognize the impossibility of handling large boulders and clay with small dredges.

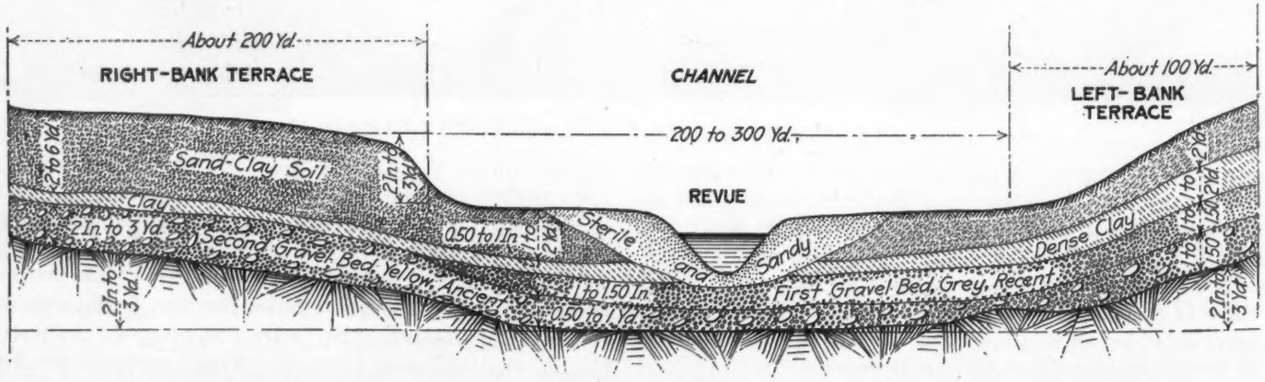
Prospecting for the Andrada Mines, Ltd., was begun in 1911 under my direction, the first work done being the prospecting of the Revue valley by shaft and Keystone drills. Since the deposits are patchy and the gold coarse, shafts have been utilized to determine the composition and value of the ground. The Keystone drill is used on a large scale, but only for verification.

The valley is divided into three different parts—one channel in the center about 600 ft. wide and terraces of variable widths, extending sometimes to 600 ft. on each side. The channel, which is the valuable part, is covered with swamp and strewn here and there with ancient workings, the composition being shown in the accompanying sketch drawings of the Revue valley. The alluvial ground is composed of 6 to 8 ft. of overburden, containing sometimes some very sticky clay, and 6 to 8 ft. of pay wash. The latter is divided into two layers. The top one is recent and poor, and the second is a yellow, ancient deposit that is cemented and rather rich. It contains coarse pebbles and boulders. On the terraces the wash is composed of from 4 to 6 ft. of ancient yellow and rich gravel, but is covered by 15 to 30 ft. of sticky clay and soil. The bedrock of this alluvial formation is soft, decomposed schist, favorable for dredging operations. The gold is usually coarse, and even when fine, it is heavy and easy to recover. It averages about 920 points of gold and 70 of silver fine. The total length of the payable alluvial in the Revue valley is about 12 mi., with an average width of 1,000 ft. At the end of 1912 a 7½-cu.ft. dredge was ordered from the Bucyrus Co., of Milwaukee. The installation of the plant for alluvial exploitation began in 1913. The equipment consisted of a dredge, complete repair shop and a hydraulic power plant able to supply 1,000 hp. This plant was built in the Inhyamucarara Mountains, 14 km. from the dredge. It consists of a ditch 4 km. long, a pipe line of 1,200 m., with a fall of 320 m., to the power station, a thoroughly uptodate plant with automatic apparatus promising security and continuity. Power is obtained through two Pelton turbines of 500 hp. each, coupled with two three-phase generators. The current is generated at 4,250 volts and transmitted to the dredge camp at 15,000 volts, and for use is stepped down to 2,000 volts. The dredge, called the "Alpha," is a modern steel plant of the California close-connected, chain type having digging buckets of 7½-cu.ft. capacity. The hull is 150 ft. long, 40 ft. wide and 9 ft. deep. The revolving screen is 35 ft. long, and the tables are covered with Hungarian riffles. The stacker is 60 ft. long. The dredge steps ahead with two steel spuds weighing 14 tons each. The total weight of the dredge complete is 800 tons. The erection was started in June, 1913, and completed in October of the same year.



SECTION OF THE SURFACE DEPOSIT

From. Feb. 10, 1914, to June 30, 1915, the dredge handled 1,931,051 cu.yd. and recovered gold valued at 1,749,495 francs—that is to say a unit recovery of 90 centimes, or 18c. per cu.yd. The average expenses during this time have been 44 centimes, or 8c. per cu.yd., this including prospecting, developing and all general ex-



A SECTION OF THE REVUE VALLEY, SHOWING THE TERRACES, CHANNEL AND GRAVEL BEDS

penses in Mozambique and at London and Paris, but does not include any amortization.

The ground contains a great quantity of large boulders, and the Revue proposition would have been a failure had it not been possible to eliminate them quickly and cheaply. The Andrada Mines, Ltd., inaugurated the new system of breaking up the boulders in the buckets themselves, using a small charge of dynamite put on top of the boulder and covered with clay. The boulders are thus cracked by the blasting, and they can be sent to the hopper without risk of damage. The system has given splendid results. The average time lost per boulder is from one to two minutes, according to size and hardness of the rock.

The bucket line was changed in August, 1915, after about 19 months of work. During this time the buckets were subjected to approximately 8,000 blastings, or more than one hundred shots per bucket, and there was no accident during this time, nor did any damage result.

The dredge is working in a pond about 1,000 ft. wide, sometimes increasing to 1,200 ft. Half a cut is worked during a week, with one sheave on shore and the other fixed on a boat anchored in the middle of the pond. The following week the dredge works the other half of the cut, after having changed the necessary cables. Only 4 hr. weekly is lost in making this change. The wide pond allows fairly regular monthly outputs in spite of the very packy ground.

Some Better Kutter's Formula Coefficients*

The ordinary category of coefficients of roughness for use in the Kutter formula (which may be found in various books on hydraulic calculations) lists, as a rule, not more than 12 to 25 classes of pipes, conduits and channels, with one coefficient of roughness for each. This number of classes of channels is too limited; and the number of values of the coefficient and the range of value are not sufficient to cover modern requirements in calculation. Furthermore, various types of channels and conduits now frequently used are not listed at all in the older schedules.

It is well known that to select the proper coefficient of roughness to be applied under given conditions in connection with the Kutter formula requires considerable experience and judgment. The working engineer is loath to spend his time hunting through original sources of data and experiments, and the range of intermediate values between those given in the existing schedules is so wide as to leave large room for error or diversity of opinion. Many values of the coefficient of roughness for new conditions have been recently worked out and published.

In order to facilitate the rapid selection of satisfactory values of the coefficient of roughness and to standardize office-engineering practice in such calculations, the writer has made out the accompanying table of coefficients. In this table four coefficients of roughness are given for each class of channel or conduit, the intention being to cover the usual range of values occurring in actual experience and also to include the values that may be expected to apply to new work in the best order and condition and to pipes or channels that have been in use for a greater or less length of time.

Obviously it is necessary to use different values of the coefficient of roughness for the same channel, according to the conditions to be met. For example, if the thing to be determined is the actual quantity of water that a pipe will carry when new, then the coefficient for the pipe in perfect order should be used. However, if, as is often the case in designing, it is desired to provide pipe or conduit capacity sufficient to convey a certain amount of water when the pipe or conduit has been in use for a term of years, a higher coefficient of roughness will in general be required.

NEW TABLE OF n FOR KUTTER'S FORMULA (R. E. Horton)

Surface	Perfect	Good	Fair	Bad
Uncoated cast-iron pipe	0.012	0.013	0.014	0.015
Coated cast-iron pipe	0.011	0.012*	0.013*	.....
Commercial wrought-iron pipe, black	0.012	0.013	0.014	0.015
Commercial wrought-iron pipe, galvanized	0.013	0.014	0.015	0.017
Smooth brass and glass pipe	0.009	0.010	0.011	0.013
Smooth lockbar and welded "OD" pipe	0.010	0.011*	0.013*	.....
Riveted and spiral steel pipe	0.013	0.015*	0.017*	.....
Vitrified sewer pipe	0.010 / 0.011	0.013*	0.015	0.017
Glazed brickwork	0.011	0.012	0.013*	0.015
Brick in cement mortar; brick sewers	0.012	0.013	0.015*	0.017
Neat-cement surfaces	0.010	0.011	0.012	0.013
Cement-mortar surfaces	0.011	0.012	0.013*	0.015
Concrete pipe	0.012	0.013	0.015	0.016
Wood-stave pipe	0.010	0.011	0.012	0.013
Plank Flumes:				
Planed	0.010	0.012*	0.013	0.014
Unplaned	0.011	0.013*	0.014	0.015
With battens	0.012	0.015*	0.016	.....
Concrete-lined channels	0.012	0.014*	0.016*	0.018
Cement-rubble surface	0.017	0.020	0.025	0.030
Dry-rubble surface	0.025	0.030	0.033	0.035
Dressed ashlar surface	0.013	0.014	0.015	0.017
Semicircular metal flumes, smooth	0.011	0.012	0.013	0.015
Semicircular metal flumes, corrugated	0.0225	0.025	0.0275	0.030
Canals and Ditches:				
Earth, straight and uniform	0.017	0.020	0.0225*	0.025
Rock cuts, smooth and uniform	0.025	0.030	0.033*	0.035
Rock cuts, jagged and irregular	0.035	0.040	0.045	.....
Winding sluggish canals	0.0225	0.025*	0.0275	0.030
Dredged earth channels	0.025	0.0275*	0.030	0.033
Canals with rough stony beds, weeds on earth banks	0.025	0.030	0.035*	0.040
Earth bottom, rubble sides	0.028	0.030*	0.033*	0.035
Natural Stream Channels:				
(1) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.0275	0.030	0.033
(2) Same as (1), but some weeds and stones	0.030	0.033	0.035	0.040
(3) Winding, some pools and shoals, clean	0.035	0.040	0.045	0.050
(4) Same as (3), lower stages, more ineffective slope and sections	0.040	0.045	0.050	0.055
(5) Same as (3), some weeds and stones	0.033	0.035	0.040	0.045
(6) Same as (4), stony sections	0.045	0.050	0.055	0.060
(7) Sluggish river reaches, rather weedy or with very deep pools	0.050	0.060	0.070	0.080
(8) Very weedy reaches	0.075	0.100	0.125	0.150

*Values commonly used in designing.

Leasing Contract Liability

By A. L. H. Street*

Owners of iron-ore lands are entitled to a decree for specific performance of a contract by another and his assignee to take a lease on the lands on specified conditions, if the owners have remained ready and able to perform their part of the contract. Judgment may also be entered against the lessees for minimum royalties already accrued under the contract. So held the Supreme Court of Appeals of Virginia in the recent case of Hairston vs. Hill, 87 Southeastern Reporter, 573, where defendants unsuccessfully claimed that the agreement in question was not a binding contract, but merely a contract for an option which they did not exercise.

Incidentally, the court holds that the fact that the person who originally agreed to take the lease assigned his rights under the contract to a corporation formed by him did not absolve him from legal obligation to see that the agreed royalties were paid and that the terms of the contract were carried out on the lessee's part.

*Excerpt from article by Robert E. Horton, consulting hydraulic engineer, 57 North Pine Ave., Albany, N. Y., in "Engineering News," Feb. 24, 1916.

*Attorney at law, 829 Security Building, Minneapolis, Minn.

Concreting the Barron Shaft in Pachuca, Mexico

By J. E. Smith*

SYNOPSIS—A squeezed shaft repaired by 1,386 cu.m. of reinforced concrete, in a war-ridden country, where the mining staff stole a railroad train to transport stolen cement to complete this job. Different sections were devised for various parts of shaft to meet varying conditions of pressure. Owing to abnormal conditions of foreign exchange and labor situation, cost of doing work was only between one-half and five-eighths what it would have been under normal conditions.

The following is a description of the work performed in concreting a dangerous section of the Barron shaft in the mine of that name belonging to the Compañia Real del Monte y Pachuca, Pachuca, Hidalgo, Mexico. The Real del Monte company is a subsidiary of the United States Smelting, Refining and Mining Co., of Boston, and is perhaps the largest single producer of silver in the world, normally employing approximately 4,000 Mexicans and operating eight independent mines in the districts of Pachuca and Real del Monte, 67 mi. northeast of Mexico City. The Barron lies between the famous Santa Gertrudis and La Blanca mines in the Pachuca district.

The Santa Gertrudis-Barron vein lies in a wide shear zone having a dip to the south of about 55°. The Barron shaft, like nearly every other shaft in the district, is vertical, and about 80 m. of its vertical length lies within the sheared territory of the vein. The shaft is old, was sunk before modern methods were in vogue, the workings of earlier days closely surrounded the shaft, which was inadequately protected in the whole of the shear zone, and a great deal of actual movement has taken place between the solid hanging and foot walls of the shear zone, which, outside of the uartz vein, is largely filled with movement clay.

Maintenance of Shaft Difficult

For several years this section was a source of constant expense and difficulty in the maintenance of the shaft, constant retimbering being necessary to avoid complete closure of the shaft by squeeze in the bad section.

About three years ago a considerable area was excavated all around the shaft in the bad portion and skeleton sets of 12x12 timbers were placed around the actual shaft sets (Fig. 4), leaving between the two sets of timbers a space of 3 ft. in which men could work, for the constant relieving of the outer timbers from the pressure of the surrounding clay and crushed rock. While this was effective for a time, continual shaft difficulties caused the management, in June of last year, to decide upon the concreting work here described.

Throughout the entire period during which the work was performed, Pachuca was completely cut off from railroad, telegraph and telephone connection with the surrounding world, there having been a dozen changes of martial-law government during a period of a few months, as one faction after another took possession of the town. The cement for the entire job was brought in, from a cement factory 40 mi. away, on a train stolen and run by employees of the Real del Monte company, who, under circumstances of extreme danger, choosing a propitious moment in hostilities, managed to get out from Pachuca to the factory and back with several carloads of cement hastily loaded from the abandoned warehouse of the defunct plant.

Rates of exchange, and therefore the costs in Mexican currency of all things from labor to rock, fluctuated rapidly during the period. Costs are given in two columns, one representing the actual cost under the circumstances of exchange existing at the time the work was done figured into United States currency, the other being what the same work would have cost under normal conditions. It is interesting to note that under the abnormal and difficult conditions obtaining, the work cost only a little more than half what it would have cost in peace times.

Cause of Shaft Squeeze

Just before the concreting was begun, the total inability to bring timber or other supplies from the outside world prevented repairs and resulted in the timbered portion of the shaft being so crushed as to practically close it for a considerable length, so that the shaft had to be bulkheaded to prevent its entire destruction. The concrete work was begun under circumstances of extreme danger, especially as it was decided to remove all possible timber from the shaft as the concrete work proceeded. Some timbers it was found totally impossible to remove except at undue risk. Concrete was poured solidly around these with the expectation of removing them after the concrete had completely set. The volume of such timbers is negligible. The job was finished in remarkably quick time and without casualty of any kind.

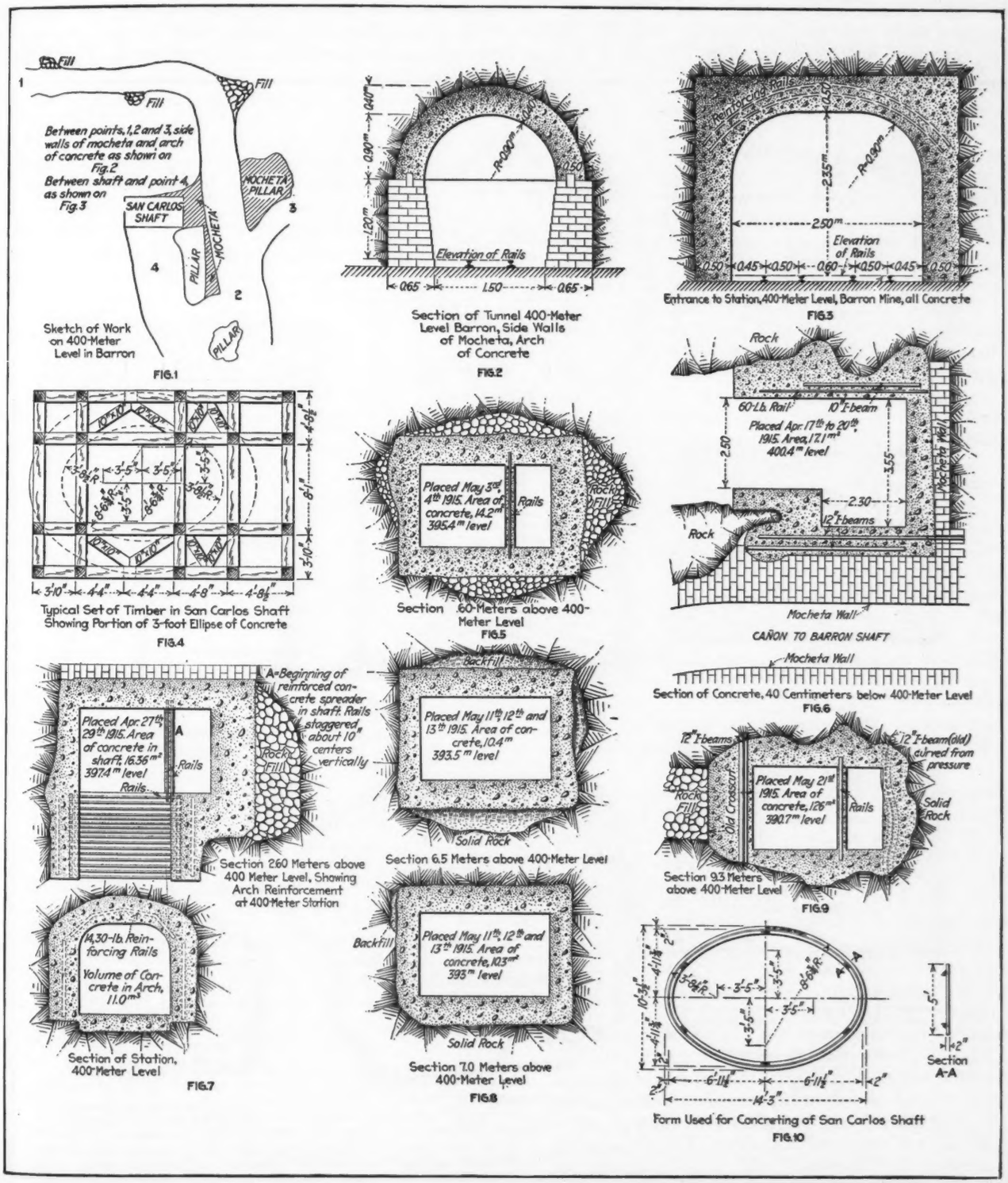
The most of the trouble in the shaft was experienced in the region where it is crossed by the vein, about the 555-m. level. There had been some trouble below this, however, and it was decided to start on the 400-m. level with a good foundation. The workings surrounding the shaft on this level were reinforced as shown in Figs. 1, 2 and 3. The shaft was timbered with double sets in the part that had given trouble—from the 390-m. level to the 330-m. level—and the rest with single sets (see Fig. 4).

From the 400-m. level to the 390-m. level, where there were single sets of timber, concrete was put in square with one spreader, out to solid ground or to a minimum of 2 ft. in thickness (see Fig. 5). There was no evidence of great pressure in this part. Figs. 6 to 9 show details of this part of the work. For the section from this point up, where there were double sets, an elliptical form for concreting was adopted on account of the nature of

*Mechanical engineer, Compañia Real del Monte y Pachuca, who was in charge of the work and made the report to C. W. Van Law, vice-president and general manager, Boston, Mass., by whose permission it is here published.

pressure. Fig. 4 shows how the ellipse was placed with regard to sets, and Fig. 10 shows the collapsible form used. The first double set was above the 12-in. I-beams at the 390.7-m. level (see Fig. 9), and from here up to the 388-m. point concrete was put in to solid rock as shown, the section being modified as shown in Figs. 11 and 12 to support the elliptical section to be put in above. On this base the first elliptical section was placed. (See Fig. 12, which shows relative positions of elliptical and square sections of shaft.) From here up concrete ring of section shown was put in, a dry rock wall being built out to solid rock. Five forms were used (Fig. 10), and the work went on at the rate of one form, or 5 ft., per day; therefore the concrete had four days to set before any weight whatever was put on it. The timber was put in 5 ft. between sets.

Fig. 13 shows the surface arrangements of the concrete plant. Rock was taken from the dump and sent by

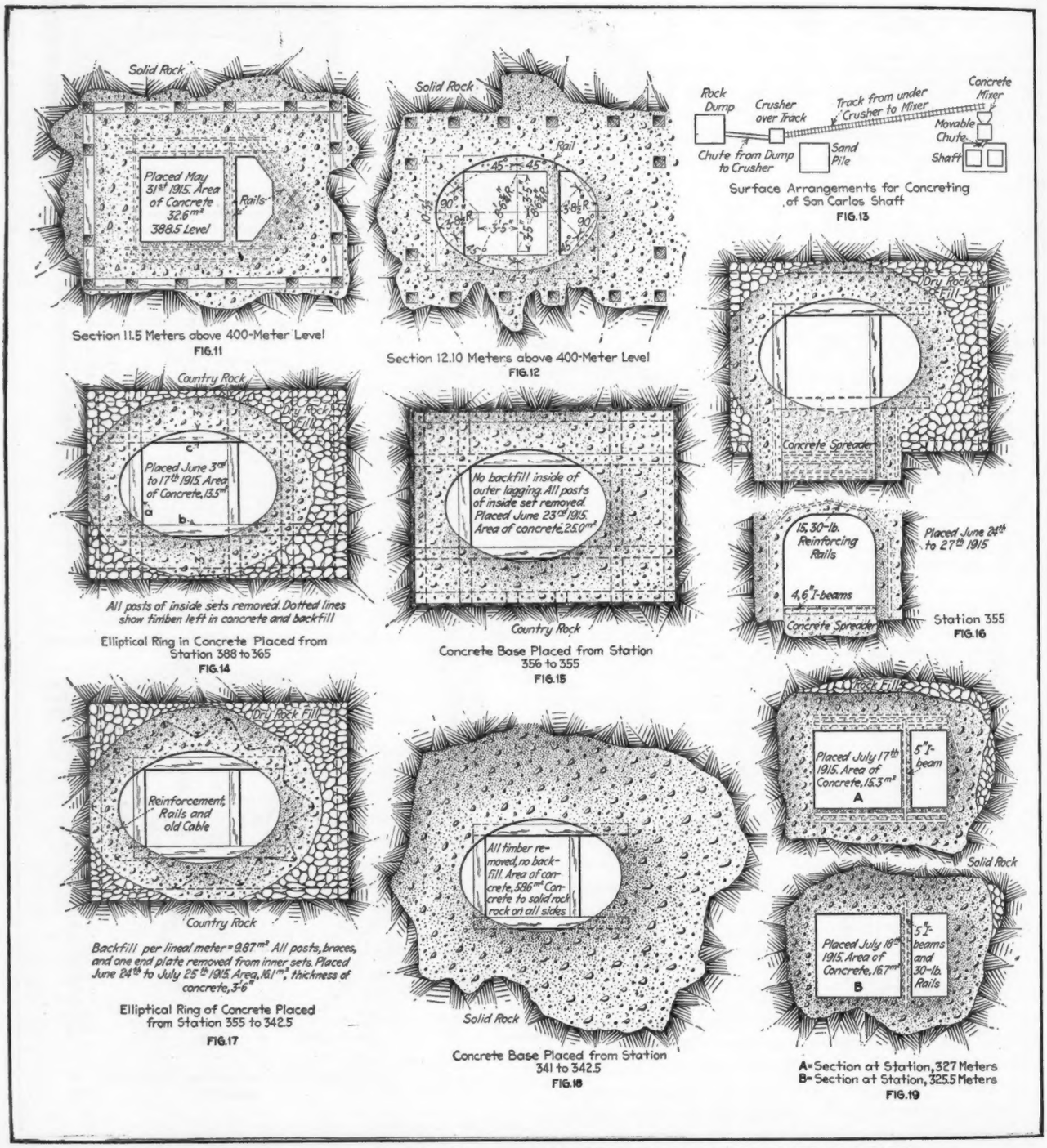

Fill
Between points 1, 2 and 3, side walls of mocheta and arch of concrete as shown on Fig. 2
Between shaft and point 4, as shown on Fig. 3
SAN CARLOS SHAFT
MOCHETA PILLAR
MOCHETA
PILLAR
Sketch of Work on 400-Meter Level in Barron
F16.1
Elevation of Rails
Section of Tunnel 400-Meter Level Barron, Side Walls of Mocheta, Arch of Concrete
F16.2
Reinforcing Rails
Elevation of Rails
Entrance to Station, 400-Meter Level, Barron Mine, all Concrete
F16.3
Typical Set of Timber in San Carlos Shaft Showing Portion of 3-foot Ellipse of Concrete
F16.4
Placed May 3rd 4th 1915. Area of concrete, 14.2m² 395.4m level
Rails
Rock Fill
Section 60 Meters above 400-Meter Level
F16.5
Rock
60-Lb. Rail
10" I-beam
Placed Apr. 17th to 20th 1915. Area, 17.1m² 400.4m level
12" I-beams
Mocheta Wall
CAÑON TO BARRON SHAFT
Placed Apr. 27th 29th 1915. Area of concrete in shaft, 16.36m² 397.4m level
A=Beginning of reinforced concrete spreader in shaft. Rails staggered about 10" centers vertically
Section 2.60 Meters above 400 Meter Level, Showing Arch Reinforcement at 400-Meter Station
Backfill
Placed May 11th 12th and 13th 1915. Area of concrete, 10.4m² 393.5m level
Solid Rock
Section 6.5 Meters above 400-Meter Level
Mocheta Wall
Section of Concrete, 40 Centimeters below 400-Meter Level
F16.6
12" I-beams
12" I-beam (old) curved from pressure
Old Crosscut
Placed May 21st 1915. Area of concrete, 12.6m² 390.7m level
Solid Rock
Section 9.3 Meters above 400-Meter Level
F16.9
14,30-lb. Reinforcing Rails
Volume of Concrete in Arch, 11.0m³
Section of Station, 400-Meter Level
F16.7
Placed May 11th 12th and 13th 1915. Area of concrete, 10.3m² 393m level
Section 7.0 Meters above 400-Meter Level
F16.8
Section A-A
Form Used for Concreting of San Carlos Shaft
F16.10

FIGS. 1 TO 10. DETAILS OF SECTIONS OF CONCRETE WORK IN THE BARRON SHAFT

chute to the rock breaker, which discharged into car as shown. A concrete mixer of Ransome type, built on the job, was used. There were two boxes of 1 cu.ft. each, one in each cage compartment, and the mixer discharged directly into these. These boxes had doors in the bottom, and the concrete was shot direct from them to its place in the shaft by means of a trough. There was no difficulty in doing one form of 5 ft. per day.

The work was done in three shifts. The first shift removed timbers and placed forms, the second put in dry-wall backfill, and the third placed concrete. In concrete work, rock was used directly from the crusher and contained some fines, therefore a 1:2½:5 mixture was used in the worst parts, 1:3:6 being used in the rest. "Plums" (large rocks placed by hand in concrete) were used, averaging about 10% of the entire volume. Drainage holes were put in at convenient distances depending on amount of backfill, etc.

In general, a ring of concrete 3 ft. in thickness was put in (Fig. 14), but this was varied somewhat according to conditions. From the 356-m. level to the 355-m. level a base was put in, as shown in Figs. 15 and 16. Above this to the 342-m. level was the worst section of the shaft, and the thickness of concrete was increased to 3 ft. 6 in. (Fig. 17); reinforcement of rails vertically and old cable horizontally also were used. From the


Solid Rock
Placed May 31st 1915. Area of Concrete 32.6 m²
388.5 Level
Rails
Section 11.5 Meters above 400-Meter Level
FIG.11
Solid Rock
Rail
Section 12.10 Meters above 400-Meter Level
FIG.12
Rock Dump
Crusher over Track
Track from under Crusher to Mixer
Concrete Mixer
Movable Chute
Chute from Dump to Crusher
Sand Pile
Shaft
Surface Arrangements for Concreting of San Carlos Shaft
FIG.13
Country Rock
Dry Rock Fill
Placed June 3rd to 17th 1915. Area of Concrete, 13.5 m²
All posts of inside sets removed. Dotted lines show timber left in concrete and backfill
Elliptical Ring in Concrete Placed from Station 388 to 365
FIG.14
No backfill inside of outer lagging. All posts of inside set removed. Placed June 23rd 1915. Area of concrete, 25.0 m²
Country Rock
Concrete Base Placed from Station 356 to 355
FIG.15
Dry Rock Fill
Concrete Spreader
15, 30-lb. Reinforcing Rails
4,6" I-beams
Concrete Spreader
Placed June 24th to 27th 1915
Station 355
FIG.16
Dry Rock Fill
Reinforcement, Rails and old Cable
Country Rock
Backfill per lineal meter = 9.87 m² All posts, braces, and one end plate removed from inner sets. Placed June 24th to July 25th 1915. Area, 16.1 m², thickness of concrete, 3'6"
Elliptical Ring of Concrete Placed from Station 355 to 342.5
FIG.17
All timber removed, no backfill. Area of concrete, 58.6 m² Concrete to solid rock rock on all sides
Solid Rock
Concrete Base Placed from Station 341 to 342.5
FIG.18
Rock Fill
Placed July 17th 1915. Area of Concrete, 15.3 m²
A
5" I-beam
Solid Rock
Placed July 19th 1915. Area of Concrete, 16.7 m²
B
5" I-beams and 30-lb. Rails
A=Section at Station, 327 Meters
B=Section at Station, 325.5 Meters
FIG.19

FIGS. 11 TO 19. DETAILS OF SECTIONS OF CONCRETE WORK IN THE BARRON SHAFT

342.5-m. to the 341-m. level the base shown in Fig. 18 was put in. In this part, between the two bases mentioned, the shaft caved and there were several large bodies of loose rock outside of timbers held in place with wedges, etc. It was not deemed feasible to remove all of this, so it was filled as well as possible and a grout run in outside of the concrete ring. As shown in sketches, all posts and braces were removed, and in the worst ground all timber except pieces *a, b, c,* Fig. 14, was removed. The last double set was at the 330-m. level, and from here up the square section used below was put in (Fig. 19). This section was run up to the 319-m. level where old "mocheta" (cut stone) lining in shaft was in good condition. Stations were put in at 380-m., 355-m. and 330-m. levels similar to that at 400-m. level, Fig. 6.

There were 1,386 cu.m. of concrete placed, which contained 126 cu.m. of "plums," there being therefore 1,260 cu.m. of actual concrete. There were 670 cu.m. of backfill.

In the following statement, the actual cost in United States currency has been given and, in parallel columns,

THE TOTAL COST OF THE WORK
All Figures in U. S. Currency

	Actual	Calculated at 2 to 1 Exch.
Labor	$1,941.11	$7,943.00
Material	5,161.50	5,786.87
Engineering and supervision	1,423.90	1,423.90
Various	691.63	900.00
Total	$9,218.14	$16,053.77
Cost of Materials:		
Cement, 293.1 tons @ $15	$4,412.37 @ $15.00	$4,412.30
Sand, 591 cu.m. @ 0.29	170.95 @ 0.85	501.07
Various	464.23	582.00
"Mocheta" (cut stone) @ 0.166	67.84 @ 0.50	204.00
Lime, 17.5 tons @ 2.62	46.11 @ 5.00	87.50
Total	$5,161.50	$5,786.87
Cost of Concrete and Work in Shaft per Cubic Meter:		
Mixing	$0.096	$0.393
Placing	0.168	0.687
Transp. sand and rock	0.109	0.446
Sand	0.122	0.357
Rock	0.136	0.556
Cement	3.500	3.500
Total	$4.131	$5.939
Backfill:		
Rock and transp	$0.277	$1.163
Placing	0.179	0.732
Total	$0.210	$1.865
Placing timber and forms	$0.210	$0.859

Total cost subdivided:	Actual	At 2 to 1
1 Concrete work, 1,260 m. @ 4.131	$5,205.06 @ 5.939	$7,483.14
2 Plums, 126 m. @ 0.40	50.40 @ 1.637	206.24
3 Backfill, 670 m. @ 0.456	305.52 @ 1.865	1,249.55
4 Timber and form labor, 1260 m. @ 0.21	264.60 @ 0.859	1,082.34
5 Various labor	679.25	2,781.55
6 Various material and power	1,289.41	1,827.05
7 Engineering and supervision	1,423.90	1,423.90
Total	$9,218.14	$16,053.77
Total cost per cu.m.	$6.65	$11.58

Various labor includes setting crusher and surface arrangements, building forms, clearing in shaft, extra work due to stations, moving pipe line, grouting in bad sections and reinforcements.

Various material and labor includes mixer, timber, material for forms, material for stations, material for reinforcement, etc.

the figures that would have applied had work been done in normal times. During the time the work was being done, the exchange rate varied from 6 to 1, to 14 to 1. The cost of labor and material both varied in different proportions to the exchange and to each other.

Timbermen and Laborers in the New York Subways, numbering about 7,000 men, went on strike Apr. 3 for higher wages. Only about 500 timbermen, on whose labor depended the safety of the shoring of the streets, were left at work. Workers to the number of 3,500, including drill runners, tool sharpeners, dynamite foremen and blasters, who are not members of the Tunnel and Subway Constructors' Union, reported for work as usual, but a sympathetic strike will follow the employment of strike-breakers.

The Malm Process

About a year ago much interest was excited by the news that the Bunker Hill & Sullivan Mining and Concentrating Co. had taken up the Malm process and was going to erect a plant to use it in connection with the treatment of its ores at Kellogg, Idaho. Since then but little has been heard about this subject, and there has been a good deal of inquiry respecting the results of the experimental work that was being conducted on a large scale. The following information comes from an authoritative source.

The early experience of the Bunker Hill & Sullivan company with the Malm process extended over the period of about five months, and the laboratory tests indicated an astonishingly high extraction of the lead, silver and zinc of the slime tailings from the concentrating mill, which was the material tested and which it was especially desirable to treat. Parenthetically it may be remarked that since then the company has been able to recover the metals lost in that product, to a large extent by the application of the flotation process. Mr. Malm and his associate, Mr. Ionides, urged the purchase at foreclosure sale of the equipment in their Georgetown plant. That plant had not been fully completed and had never been run, not even in part. The whole thing was taken to Kellogg, Idaho, and installed there in an unused portion of the mill, it being turned over to Mr. Malm on a monthly salary arrangement.

The first difficulty was found to be in performing the electrolytic decomposition of fused zinc chloride for the production of chlorine gas and metallic zinc. All demonstrations and tests of the process had previously been made with chlorine gas purchased in cylinders. Finally some members of the Bunker Hill & Sullivan staff constructed electrolytic zinc cells according to their own ideas, which they operated with a fair degree of success for about two months, producing chlorine gas for continuance of the experiments, together with metallic zinc, a carload of zinc chloride having been purchased for the purpose of starting the cycle. The Bunker Hill & Sullivan metallurgical staff is of the opinion that no one ever went so far in the electrolysis of fused zinc chloride as it did. The staff is now strongly of the opinion that the process cannot be a commercial one in the hands of anybody.

There are many mechanical difficulties in the handling of the fused chloride and in making a regular output of chlorine gas. The best that could be done with the largest cell constructed at Kellogg was a production of about 200 lb. of zinc in 24 hr. The operation of a plant of any considerable size would require a huge number of cells.

In the trial of the Malm process at Kellogg, neither the roasting nor the lixiviation work was satisfactory. The acid-resisting filter failed, and the plans for precipitating lead, and the recovery of zinc chloride by building up the sulphate to saturation followed by evaporation, did not work out at all. There are considered to be some attractive things about the process, which, however, are regarded as not new. This has reference particularly to the reaction of chlorine gas on the dry ore.

The subsequent handling of the lixiviate and the regeneration of the chlorine are the stages wherein the serious difficulties arise. The Bunker Hill & Sullivan company abandoned the Malm process during the fall of 1914,

since which time it has been doing satisfactory work in a small way by sulphate roasting, brine leaching, lime precipitation and electrolysis. The work with a chlorine process at Helena, which was conducted along lines similar to those of the Malm process, was equally unsuccessful.

Tungsten in Arizona

By William P. De Wolf

Prospecting for tungsten in the pegmatite belts of Yavapai County has resulted in the discovery of hübnerite and wolframite deposits of value in the Eureka, Tip Top and Tule Creek districts. Shipments of ore carrying a high percentage of tungsten have been forwarded to Pittsburgh and to Denver, where they met with a ready sale at top market prices. Tungsten ore is being mined in this section of Arizona under conditions indicating a source of supply equal to that of the Boulder district of Colorado.

The energizing of the tungsten-mining industry of Yavapai County, brought about by the conditions mentioned, has produced results beyond the most sanguine expectations of the operators. This, in turn, has incited the prospectors to search more diligently for the mineral and has attracted them to the local field from all portions of the Southwest. The summer is expected to record additions to their ranks and result in tungsten finds in outlying sections of Yavapai County that are as yet inaccessible because of the snow.

First Tungsten Discovery in Arizona

To Homer Wood, of Prescott, is due the present status of Yavapai's tungsten-mining industry. About 18 months ago he became convinced that the pegmatite areas of this county might produce tungsten ores. Since then he has devoted his time, energy and money to their development and has achieved a degree of success that has strengthened his conviction in their worth and encouraged others to engage in the work. Mr. Wood has supplied 70 or more prospectors with the necessary acids, etc., for making tungsten tests in the field.

The first discovery of tungsten ore in Yavapai County was made by William Connors, in April, 1914, in the Eureka district. The Connors property is one of a number in which Mr. Wood is interested. Development consists of a number of shallow workings extending for 1,500 ft. along one of a number of ledges that traverse the group of 13 claims. Hübnerite and wolframite occur in all of the workings and on all of the claims, including a large placer acreage. The latter is to be worked extensively as soon as weather conditions will permit. In the meantime Connors is developing the hübnerite and wolframite lode deposits and is sacking ore carrying 71.13% tungsten. The pegmatite area of the Eureka district is extensive and, so far as prospected, is known to be tungsten-bearing, but a considerable area is still open.

John Seiss and Asa Bozarth are mining and sacking tungsten ore on a group of claims adjoining the Connors locations. Robert Robbins and Orville Bozarth are working another group and are sacking tungsten for shipment. Mark Ferguson is mining tungsten of commercial grade. Frank Williams recently sent a test shipment of tungsten to Denver; returns have not as yet been received. E. S. Temple, of Boulder, Colo., is developing a group of tungsten claims in that section with encouraging results. Conditions seem favorable for a regular and remunerative production of tungsten ore from the entire pegmatite belt of the Eureka district.

There is 20,000 tons of ore, estimated to carry 1½% tungsten, on the dump of the Tip Top mine in the Tip Top district. This is the largest producer of tungsten in Yavapai County. In former years it was one of the richest silver mines in Arizona, and at that time a large tonnage of ore that the operators classified as blackjack, but which has recently been determined to be wolframite, was thrown over the dump as valueless. A much larger tonnage was left standing in the drifts and stopes. All the tonnage in the mine workings and on the dump is now valuable, as it is available for reduction at a much lower cost than if the orebodies had to be prospected and developed. The tungsten-yielding possibilities of the Tip Top mine are duplicated in other old silver mines of that section, many of which will yield profits to a remarkable extent.

George Wingfield, of Goldfield fame, has taken an option on the Tip Top mine. A mill—as yet in an experimental stage—is being utilized for the reduction of the tungsten ores. When perfected it will handle a considerable tonnage, but will be available only for the Tip Top's ores. During his first trip to the property, Mr. Wingfield's engineer optioned the tungsten holdings of J. C. Gardner. The sum involved is said to approximate $45,000.

Development of High-Grade Ore

Gardner owns five claims in the Tule Creek section. He is sacking hand-sorted ore that carries 50% mineral. Several weeks ago Gardner, in conjunction with George Thompson, shipped a batch of wolframite ore to Denver, where it was marketed at $45 per unit. The shipment was made for the purpose of ascertaining what can be done with a 40% product, rather than with the object of securing funds for further development of the orebody. Thompson is sacking ore on his group of claims and will ship to Pittsburgh as soon as the roads are passable for freight teams.

The tungsten-bearing area, extending from the Tule Creek district to Tip Top and beyond, is extensive, and a considerable area is still open to location. The pegmatite appears as a centralized dike with isolated outcrops that have no surface connection with the main body. A number of old silver mines along this pegmatite belt are now being prospected for tungsten with gratifying results. In the Crown King section there is another pegmatite area that seems promising. All of these areas will doubtless be thoroughly prospected during the spring and summer months.

E. J. Trevaro and J. C. McDonald, former mine operators in the Cripple Creek district, have opened a good streak of tungsten ore in the Tule Creek district. The pay portion of the deposit is 5 in. wide and is readily sorted to a high-grade tungsten product. It is opened to a depth of 10 ft. Wolframite is being sacked for shipment. Near-by the Trevaro-McDonald holdings, Ed. Foltz and Frank Morgan have opened commercial ore on six claims. Jesse Davis and partner, owners of three claims half a mile north of the George Thompson holdings, have tungsten ore opened in two tunnels. Other openings of importance are appearing rapidly.

Rate of Slimes Settling*

By E. E. Free†

SYNOPSIS—The principles of the behavior of suspensions developed in the preceding articles are applied to the specific problem of the rate of settling of slimes in undisturbed tanks. It is shown that there are two types of settling and that the type that will occur in any case is determined by the initial concentration of the slime. Only the type characteristic of more concentrated slimes will yield a clear solution, so it is necessary to deliver slimes at an initial concentration above the limiting critical concentration. The factors controlling this critical concentration are discussed and the principles applied to practical problems.

The previous articles of this series have been devoted to some generalizations of colloid science that affect the behavior of colloidal slimes. Necessarily the treatment has been brief. For that reason as well as because of the importance of the matter, the present article is devoted to the definite problem of the rate of settling of slimes. To this problem we shall apply the general principles developed in the earlier articles as well as some pertinent experimental data that have not been presented previously. Obviously a great deal might be included under this problem, but for simplicity and brevity we shall discuss only free, unhindered settling in undisturbed tanks; that is, the older, discontinuous system of slimes thickening. The principles—true for such undisturbed settling—will apply, with small and obvious modifications, to the modern systems of continuous settling as well as to the settling of other sorts of sludges and suspended materials.

If we consider first the effect of the initial concentration[1] or "thickness" of slimes upon their rate of settling and if we examine the whole range of possible concentrations from the thinnest and most dilute to the thickest and most concentrated, we discover that two different types of settling are displayed. In dilute slimes the particles fall individually and gradually accumulate on the bottom of the container. The suspension clears slowly and continuously throughout its entire volume. Concentrated slimes behave differently. There appears at the top of the suspension a layer of clear liquid separated by a sharp surface from the slimes suspension below. As the slimes settle, this surface falls and more and more of the clear solution appears above. The slimes fall as an assemblage of particles—not by individual particles.

Two Contrasted Types of Settling

It is important to get this distinction clearly in mind. The type characteristic of dilute suspensions can be thought of as the separation of solid particles out of a suspension continually growing more dilute. The more concentrated type can be thought of as the separation of water (or clear solution) out of a suspension continually growing more concentrated. The latter type may be regarded as the consolidation of a mass of particles, all in actual contact, the consolidation being due to the gradual attainment of a closer packing. It will be convenient to refer to this type as consolidation settling and to the other type, characteristic of dilute suspensions, as subsidence settling[2]. Most slimes encountered in practice are of fairly high initial concentration, and the consolidation type of settling is practically the more important; but actual cases of the subsidence type are not rare, as for instance, those slimes that refuse to give clear solution above the slimes mass.

From both practical and theoretical viewpoints the most important feature of this distinction between the consolidation and subsidence types of settling is the relation of these types to the concentration of slimes. The same slimes may be made to show either type of settling, depending only upon whether the concentration is low or high. This can be made clear most easily by a consideration of experimental data. Such data might be obtained under conditions of actual practice, but the details

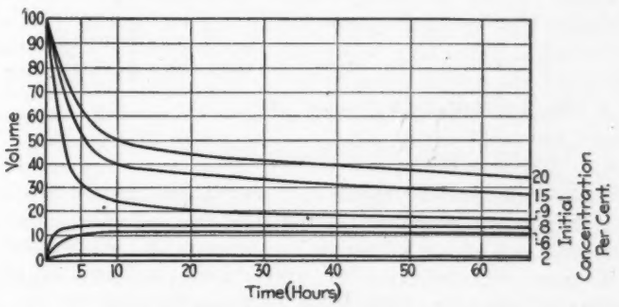


FIG. 1. SETTLING CURVES OF KAOLIN SUSPENSIONS

are better exhibited if the experiments are made in containers that are relatively deep and narrow. The vertical movements are relatively larger and more easily measured, and the discrepancies due to convection currents and other accidental disturbances are less important. Accordingly the experiments here described were made in glass tubes approximately 50 times as long as they were wide. Control experiments in containers of more normal shape have been confirmatory. Similarly, for the sake of constancy and ease of control, purified kaolin was used instead of actual slimes. Experiments with slimes themselves are fully confirmatory, but are more difficult to reproduce and to control in detail, because of accidental and unavoidable variations in their physical or chemical composition.

The distinction between the two contrasted types of settling is obvious on mere inspection of the suspensions, but it is also shown clearly by settling curves, such as are given in Fig. 1. These curves are from experiments with kaolin and give the position of the surface between

*This is the fourth of a series of articles on "Colloids in Ore Dressing." Former articles appeared in the "Journal" of Feb. 5, Mar. 4 and Mar. 18, 1916. The next article will treat of "The Control of Slimes," and will appear in an early issue.

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[1]Throughout this article the "concentration" of slimes means the percentage, by weight, of the suspended solids figured on the total weight of the suspension. Other forms of expression are frequently employed, especially the L/S (liquid-solid) ratio. The form here used is personal preference, merely. The others are equally useful and correct.

[2]O. C. Ralston, in his forthcoming paper, referred to in the preceding article, distinguishes a third type of settling characteristic of highly concentrated suspensions. I shall delay discussion of the relations of these three types until Mr. Ralston's paper has appeared.

the settled kaolin and the overlying solution or suspension at the stated times after the beginning of the settling. They are not the customary rate-of-settling curves, but show directly the actual settling. The rate at any particular point on the curve is given by the slope of the curve at that point. These curves represent slightly different things for the two types of settling described. The subsidence type characteristic of dilute suspensions is represented by the three lower curves of Fig. 1, corresponding to kaolin concentrations of 2, 6 and 8% respectively. In this type of settling the kaolin gradually accumulates on the bottom of the container by the continual fall of the individual particles. The surface, the movement of which is recorded by the settling curve, is the upper surface of this accumulating kaolin. Above it is the suspension, always becoming less concentrated. Below it is the accumulated kaolin, which may or may not suffer further progressive consolidation within itself. As the settled kaolin accumulates and increases in volume, the surface slowly rises to a limiting, asymptotic position reached when all the kaolin has settled. The lower curves of Fig. 1 portray the rise.

With concentrated suspensions, and provided that no sand or other fast-settling material is present, no surface of demarcation appears at the bottom of the container. On the contrary, all the kaolin falls as a mass and the surface appears at the top. Above this surface is clear water. Below is the gradually consolidating mass of kaolin. As the kaolin consolidates, the surface falls until it reaches a limiting asymptotic value beyond which no perceptible consolidation occurs. The three upper curves of Fig. 1 illustrate the behavior.

Type of Settling Depends on Concentration

Since all curves of Fig. 1 represent suspensions of kaolin in water, differing only in the relative proportion (concentration) of the kaolin, it is apparent that there must be some concentration at which the type of settling changes from the subsidence to the consolidation type. In the experiments of Fig. 1 this critical concentration must lie between 8 and 9%. The attempt to place it more precisely would involve us in difficulties, owing to the fact that the transition between the two types of settling is not mathematically sharp. There is a transitional range of concentration within which the behavior of the settling kaolin is complex. Certain of these complexities will be discussed, but for the moment the essential concept is that of a critical concentration above which settling is of the consolidation type and below which it is of the subsidence type. This conception appears to be applicable to all suspensions of more than momentary persistence, including all slimes.

This critical concentration is a matter of great practical importance. Generally one wants to thicken slimes to recover solution rather than to produce drier slimes. Usually it is desired that the recovered solution be as clear and free of particles as may be possible. Only the consolidation type of settling gives clear solution at the top. In the subsidence type the solution above the settled material clears gradually and, if some of the particles be fine, very slowly. Indeed many slimes never become clear at all if settling is of the subsidence type. With the consolidation type of settling, these finest particles are swept along with the consolidating slimes and the solution above it is left fully clear. Obviously there are strong practical reasons in favor of settling of the consolidation type, and from the data presented it follows that this can be assured by increasing the initial concentration above the critical value. With most slimes this is not difficult. The occasional contrary case in which it proves impossible is usually due to an abnormally high critical concentration. This suggests a query as to possible change of the critical concentration itself. Is it not possible that the critical concentration might be altered—in this case lowered—bringing the troublesome slimes within the range of the consolidation type of settling?

Not all of the conditions determining the critical concentration are known. Many of the factors determining it appear to be related to inherent and largely unknown characteristics of the suspended material or of the medium, but the most important single factor is the degree of flocculation of the suspension. An increase in the degree of flocculation will lower the critical concentration markedly. Well-flocculated suspensions show the consolidation type of settling even when they are quite dilute. This is illustrated by the experimental data shown in Fig. 2, the curves being prepared in exactly the same way as those of Fig. 1, except that each of the suspensions was

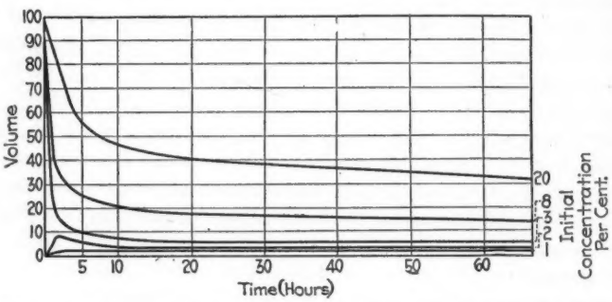


FIG. 2. SETTLING CURVES OF FLOCCULATED KAOLIN SUSPENSIONS

flocculated by 0.25 gram of common salt per 100 c.c. In the experiments of Fig. 1 (nonflocculated) only concentrations of 9% and over showed the consolidation type of settling. The critical concentration lay between 9 and 8%. In the flocculated experiments of Fig. 2, suspensions of 3% and over show the consolidation type of settling and the critical concentration lies between 2 and 3%.

Obviously, if one were troubled by a suspension of this material having, say, a concentration of 7%, it could be made to settle according to the desirable consolidation type by the addition of 0.25% of salt. Of course this would not be always a possible commercial expedient. I mean only to point out that the critical concentration as here discussed is greatly affected by the degree of flocculation of the suspension. The critical concentration can be raised or lowered and suspensions of moderate concentration made to settle according to the subsidence or the consolidation types by changes in their degree of flocculation. The ways in which this change can be produced and the possible practical utility of varying the degree of flocculation have already been discussed.

In passing we may give brief attention to one of the complexities in the behavior of suspensions near the critical concentration, indicated by the 2% curve of Fig. 2. This curve has a maximum. While it does not resemble the higher curves, representing suspensions of more than the critical concentration, neither does it show the

continual rise of the 1% curve or of the three lower curves of Fig. 1. The reason lies in the fact that a part of the flocculation existing in a flocculated suspension is not permanent, but breaks down after the flocculated material has settled, allowing a consolidation and shrinkage of the mass[3]. This behavior is characteristic of the transition zone near the critical concentration and especially with suspensions of a considerable degree of flocculation. Its only practical importance, from the present viewpoint, is that such transitional suspensions sometimes appear to settle according to the consolidation type, but nevertheless leave behind a solution not well cleared. Many of the actual cases of trouble in practice belong to this transitional class, but the controlling conditions are usually local and peculiar to each case. It is useless to attempt general discussion. Obviously the remedy, if applicable, is to increase the concentration of the slimes or the degree of flocculation, or both, until the system lies well within the range of settling according to the consolidation type. Trouble of this sort means that one is operating too near the critical concentration for the particular slimes and settling conditions concerned.

The practical conclusion that the initial concentration and degree of flocculation of the slimes should be such

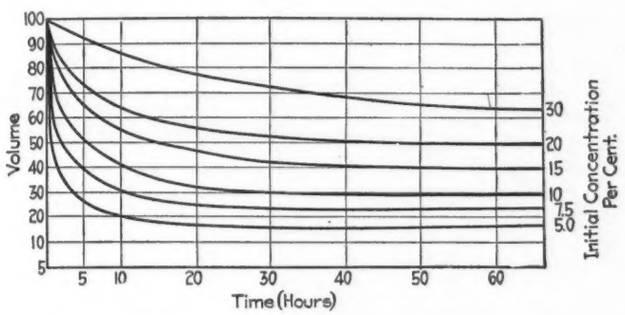


FIG. 3. SETTLING CURVES OF CONCENTRATED KAOLIN SUSPENSIONS

as to bring the settling under the consolidation type and give a clear solution is common knowledge. Indeed it may seem that in what precedes I have been laboriously developing a conclusion already self-evident. My excuse is the importance of making fully clear the rôle of the concentration of the slime in determining the type of settling. It is necessary to establish a definite conception of the critical concentration between these two types and of the way in which this critical concentration may be altered, especially by flocculation.

Taking for granted that practice can and will be adjusted to the consolidation type of settling, it is important to examine the detailed characteristics of this type. This, also, can be done best by describing certain specific experiments. Again, and for similar reasons, we have worked with purified kaolin in water and with long and narrow containers. A series of settling curves is given in Fig. 3. The suspensions possessed a moderate degree of flocculation—about what would be expected with slimes usually encountered in practice. These curves resemble in every way the upper (consolidation type) curves of Fig. 1 and Fig. 2. Three conclusions obtainable from them seem of practical importance: First, it is obvious that the rate of consolidation decreases as consolidation proceeds, being at first relatively large and falling finally to zero when the kaolin has attained its maximum consolidation. Second, this final consolidation is more quickly attained in the more dilute suspensions than in the more concentrated. In the 5% suspension consolidation is practically complete in 20 hr. after its commencement. In the 15% suspension it is complete only after some 50 hr., and in the 20 and 30% suspensions it is not yet quite complete at the end of the period shown by the curves, 66 hr. Third, the final consolidation is greater in the more concentrated suspensions. The fully settled kaolin is denser when it has settled from a suspension of greater initial concentration. This is shown by Table 1, prepared from the curves of Fig. 3, which gives the volume occupied by 100 grams of settled kaolin for each of the concentrations studied. It is probable that this greater final consolidation is due simply to the presence

TABLE 1. FINAL VOLUME OF 100 GRAMS OF KAOLIN SETTLED FROM DIFFERENT INITIAL CONCENTRATIONS

Initial Concentration %	Final Volume, C.C.	Final Volume per 100 Grams Kaolin, C.C.
30.0	618	206
20.0	482	242
15.0	388	249
10.0	288	289
7.5	239	319
5.0	168	338
2.5	107	428

of more kaolin and the consequent greater effect of its own weight.

Insofar as they express relations to initial concentration, these three deductions are independent of the degree of flocculation of the suspensions so long as this degree is the same for all. Any similarly flocculated series of suspensions differing only in concentration will show decreasing rates of settling as concentration increases, will attain final settling more quickly in the lesser concentration and will reach greater final consolidation in the greater concentrations. Between two series of suspensions similar, except that one is more flocculated than the other, the effect of greater flocculation inside the concentration range of consolidation settling is analogous to its effect in lowering the critical concentration which forms the lower concentration limit of this range. In most particulars an increase in the degree of flocculation of a given suspension makes it settle like one of higher concentration. Were the degree of flocculation increased in the suspensions of Fig. 3, the 5% curve would be more like the 7.5%, the 7.5% more like the 10%, and so on. The 30% curve would be still flatter. A decrease in degree of flocculation would have the opposite effect and, in addition, would probably cut off the lower end of the series by forcing the 5% and perhaps the 7.5% suspensions below the critical concentration and making them settle according to the subsidence type.

Some Practical Applications Considered

There will suggest themselves many practical problems to which the foregoing general principles and experimental conclusions might be applied. By way of illustration I select for analysis the following three: At what initial concentration should slimes be delivered to the settling tanks? What size and shape of settling tank is best? How can one determine in advance the capacity of a proposed settling plant?

In discussing the first of these problems we assume slimes of constant physical and chemical character and constant degree of flocculation. We deal, by previous

[3]Experimental evidence for this will be presented in a later article.

assumption, only with the problem of undisturbed, discontinuous settling. We are required to determine what initial slimes concentration is best. Of course we mean best from the standpoint of the slimes settling only. Requirements of other parts of the mill are not taken into account. Under such circumstances there is, in general, one necessary condition and two desiderata, the latter to be attained so far as possible. The necessary condition is the delivery of a clear solution. The desiderata are quick settling, which means high plant capacity, and high concentration of thickened slimes, which means small loss of solution.

The necessary condition requires that settling be of the consolidation type, which means that the initial slimes concentration employed must be above the critical concentration for the particular slimes concerned. This fixes the lower limit for the initial slimes concentration.

TABLE 2. CONCENTRATION REACHED BY CONSOLIDATING KAOLIN

After a Given Number of Hours, Starting from Different Initial Concentrations (Calculated from the Data of Fig. 3)

Initial Concentration, %....	Concentration Reached, %					
Hours Elapsed	5	7.5	10	15	20	30
1	11.8	12.7	13.4	17.8	22.3	30.3
2	13.6	14.6	14.9	19.5	23.5	31.0
4	16.4	17.0	17.5	21.9	25.7	31.7
6	18.7	19.0	19.2	23.6	27.1	32.4
8	20.8	21.0	20.8	25.1	28.4	33.1
10	22.2	22.7	22.3	26.4	29.4	33.8
12	23.3	24.0	23.6	27.2	30.4	34.4
18	25.5	26.3	26.7	28.8	32.5	36.1
24	26.2	27.3	28.8	30.7	33.9	37.6
30	26.3	27.7	29.7	32.0	35.0	39.0
36	26.4	27.8	29.9	32.9	35.7	40.2

The subsidence type of settling, which would occur below this limit, would not give a clear solution except after an impossibly long time.

The two desiderata of quick settling and great final consolidation are mutually oppositive. Settling is faster in the more dilute suspensions; final consolidation is greater in the more concentrated. Help on the matter is obtainable by some calculations from a group of settling curves like those of Fig. 3. It is possible to read directly from these curves the volumes occupied by the settled slimes after definite time intervals and to calculate therefrom the respective concentrations of the settled slimes at these times. By way of example, these concentrations, as calculated from Fig. 3, are given in Table 2 and are plotted in Fig. 4. These figures and curves show the concentration that will be attained by the settled slimes in a given time, starting from a given initial concentration. The most striking thing about the curves is that they come so close together. The faster rate of settling of the less concentrated slimes partly makes up for their greater initial dilution. For instance, one reads from Fig. 4 that after 12 hr. settling, the slimes initially 5, 7.5 and 10% have consolidated nearly to the same concentration. Even the slimes originally 30% have reached a concentration of only 34.4%, whereas the slimes originally 5% have consolidated to 23.3%. It follows that for slimes behaving like the kaolin that gave the data of Fig. 3, increase of initial slimes concentration between 5 and 30% is not of very great practical value. Most slimes do behave in this respect like the kaolin of Fig. 3, and the conclusion is probably applicable to the majority of actual slimes.

Practically, therefore, it is necessary to have the initial slimes concentration safely above the critical concentration for consolidation-type settling, but it does not matter greatly how far it is above this critical concentration. From the standpoint of the slimes plant only, there is no need to strive for high initial concentration so long as the concentration is above that which would cause settling of the other type. Applications to mill design are obvious. It is not difficult to work out for any particular slime a set of settling curves like those of Fig. 3, and from these curves one can readily determine the critical concentration for consolidation-type settling and also, by calculations like those leading to Table 2 and Fig. 4, the exact advantage that will be given by any specified increase of initial concentration. This assumes that laboratory results are really applicable to practice—an assumption concerning which there has been much dispute and to which we shall return presently.

Before passing to the second problem, a word as to flocculation is in order. The data of Fig. 3 were obtained with suspensions of a moderate degree of flocculation. Most slimes in practice are flocculated to a degree somewhere near this. If the degree of flocculation is higher, the critical concentration, and consequently the practical lower limit of initial concentration, will be lower. If the degree of flocculation be lower, this limit will be higher. The effect of a low degree of flocculation on the critical concentration is sometimes responsible for practical trouble. Slimes that have a strong tendency to become

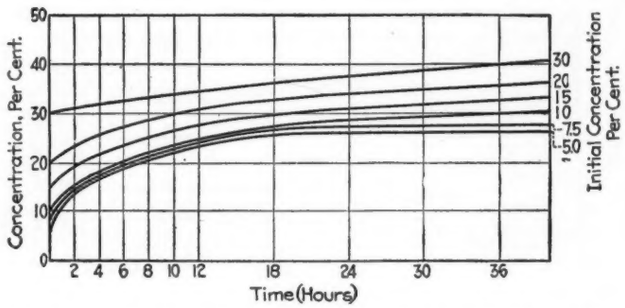


FIG. 4. DEGREE OF THICKENING IN GIVEN TIME

deflocculated have sometimes a critical concentration so high that it cannot be reached in practice. The thickest slimes that can be produced and delivered to the settling tanks are still too thin to settle according to the consolidation type of settling, and a clear solution cannot be obtained. Since the initial concentration of the slimes cannot be increased further, the remedy is to increase the degree of flocculation.

Above the critical concentration an increase of flocculation appears to bring the curves of Fig. 4 nearer together; a decrease, to push them apart. That is, the slight advantage in more rapid thickening resulting from higher initial concentration is relatively greater the less the degree of flocculation of the slimes. One cannot be dogmatic about this. Experiments are not yet sufficient for assurance, but what data are available support the conclusion stated.

Size and Shape of Settling Tanks

The second problem, that of the size and shape of settling tanks, has been much discussed, but entirely from the results of practical experience. In considering the matter from the standpoint of general principles, we confine ourselves, for obvious reasons, to settling of the consolidation type. Let us first inquire into what really causes this consolidation. Manifestly it is due to gravity acting in the form of the weight of the suspended material. In concentrated slimes all the particles may be

thought of as in contact. Consolidation is due to their acceptance of a closer arrangement. This closer arrangement is induced by the gravity, including not only the weight of the individual particles that are slipping closer together, but also the weight of superposed particles resting on them. Accordingly the compressive force and hence the consolidation will be greater at the bottom of a column of slimes than at the top and will be the more the greater the length of the column of slimes. The two desiderata of settling—quick production of clear liquid and high concentration of settled slimes—are both dependent directly upon the speed and degree of consolidation totaled for the entire slimes column. Accordingly deep tanks are to be preferred to shallow ones for concentrated slimes. The slimes at the bottom will suffer greater weight, be more compressed and take a higher degree of consolidation[4].

It is important to emphasize that this conclusion applies only to concentrated slimes. That dilute slimes behave differently is brought out by the experiments of Mishler[5] with slimes from the Tigre mill in Sonora, Mexico. Working with these slimes in various concentrations between 33 and 1.7% and in vessels of heights between 8 in. and 2 ft., Mishler found that thick slimes settled appreciably faster in the deeper vessels, but that thin slimes settled at approximately the same rate regardless of the depth of the column. This result, as well as a number of interesting details of Mishler's results, can be explained by reference to the mechanical principles of subsidence and the phenomena of temporary and permanent flocculation.

Flocculation and Rate of Fall

In a previous article of this series it was pointed out that the fall of a particle or a floccule is at a constant rate determined by its size and density and by the properties of the medium. It has been found experimentally (as will be discussed in a later article) that a part of the flocculation existing in a flocculated suspension is temporary only and breaks down when the material has subsided. Settling of the consolidation type is affected by both of these factors. With dilute slimes just beginning to settle, the amount of possible consolidation due to breakdown of floccules is large. All of the floccules are nearly of their original size and looseness of structure. All will consolidate a little on touching or on slight pressure. The total consolidation thus caused is relatively large in amount, easy and rapid. Accordingly the rate at which the top floccules of a dilute suspension can fall is not limited by the rate of consolidation below. It is limited by the rate of fall through the medium of the top floccules themselves. We have seen that this rate of fall is constant. Accordingly, with dilute slimes in the early part of their consolidation, the rate of settling is constant and is equal to the rate of fall of the individual floccules through the medium, this rate being determined by the properties of floccule and medium according to the general mechanics of suspension. When the slimes become more concentrated or if they start at a higher initial concentration, the rate at which total consolidation is permitted by breakdown of floccules is less. The floccules, being already partly consolidated, suffer further breakdown only slowly and with appreciable resistance. The total rate of consolidation of floccules becomes, therefore, less than the proper rate of fall of the upper floccules through the medium. These find themselves supported importantly from below and add their weight to the force urging further consolidation below. The rate of consolidation ceases to be constant, and the depth of the slime column begins to affect it.

All of this might be deduced equally well from the settling curves of Fig. 3, and all is in accord with experience. The practical conclusion is that deep tanks are better than shallow for concentrated slimes, but offer no important advantage for dilute slimes. What precise concentrations are "concentrated" or "dilute" in the meaning of this sentence will depend upon the properties (such as particle size and degree of flocculation) of the particular slime concerned. The precise concentrations can be determined from settling curves like those of Fig. 3 or by direct test as in Mishler's experiments.

Predicting Slime-Plant Capacity

The third problem—the prediction of the capacity of a slimes plant—is essentially the problem of how small-scale laboratory results can be made truly indicative of practical results. If laboratory tests are exactly applicable to plant conditions, it is obvious that the entire behavior of a proposed slime plant can be worked out in advance, using a small-scale duplicate of that plant. Unfortunately this is not the case. Most engineers seem to have concluded that advance laboratory study of slimes is of little help in the design of a thickening plant and that one must go at it blindly, guided only by such general good judgment as has resulted from empirical experience. With this pessimistic conclusion I cannot agree. Laboratory results can be made to supply sound indications as to the behavior of a proposed plant, but the laboratory results must be obtained and interpreted with good judgment and with full knowledge of the properties of slimes and the principles of settling in general. Probably most of the past failures are to be attributed to misinterpretations of laboratory data, due, in turn, to neglect of the fundamental mechanics of suspension.

First, it is not uncommon to attempt to predict the behavior of a given settling tank from experiments with a smaller vessel of the same relative dimensions. If the tank is to be 10x20 ft., the test vessel is made 10x20 in. The error is almost obvious. As already discussed the settling of slimes of any considerable concentration is due in part to the compressive effect of the weight of the slimes column itself. This will be greater in the deep tank than in the shallow vessel. It is the actual depth that is vital, not the ratio of depth to cross-section.

Again, it is not customary to pay any attention to flocculation. It has been shown several times in these articles that the degree of flocculation of a suspension is extremely variable and sensitive. It may be changed greatly by small amounts of foreign substances or even by the amount of shaking undergone just previous to settling. The degree of flocculation has a great effect on all features of the settling, and it is easy to see that a difference in the degree of flocculation in the tests and in the tanks may result in serious discrepancies. Such a difference might arise either through a difference in handling the test samples or through the accidental addition of some sub-

[4]This conclusion has been stated by Caetani, "Min. and Sci. Press," Vol. CVI, p. 442 (1913).

[5]"Eng. and Min. Journ.," Vol. XCIV, pp. 643-6 (1912). The earlier experiments of Nichols are confirmatory, "Trans." I. M. and M., Vol. XVII, pp. 293-329 (1908); "Min. and Sci. Press," Vol. XCVII, pp. 54-6 (1908). Important further experiments are described in the forthcoming paper of Ralston.

stance to them. For instance, I have known of laboratory tests made on a slime that had been diluted with distilled water. Of course distilled water was not used in the mill, the solution had a different composition, the degree of flocculation of the slimes was different, and one does not wonder that results failed to correspond. The analogous disturbing effects of differences in initial slimes concentration will be obvious.

Probably it is a difference in degree of flocculation that most often causes a practical discrepancy between advance laboratory results and later plant results. For this reason it is especially important that an advance study of slimes should include thorough examination of their flocculation peculiarities—of the extent to which the degree of flocculation can be affected by differences in stirring, by possible added materials, by variations in mill water, and the like. These matters are easily studied by means of settling curves like those of Fig. 3 and through the points discussed under flocculation. If one understands the flocculation peculiarities of the slimes concerned and takes account of the general principles of settling that are applicable, there is every reason to expect a satisfactory agreement between laboratory prediction and practical performance.

Suggestions for Study of a Slime

Although it is believed possible to make advance study of slimes the basis of successful plant design, it is not possible to lay down specific rules for such advance investigation. Local circumstances vary and necessarily alter the procedures to be employed. Colloid science is no more likely than other science to reach the point where it can eliminate experience and common sense in favor of rules, theories or textbook principles. Without implying the abandonment of these older and always necessary guides, certain suggestions that are likely to be useful aids may be offered as to laboratory procedures. First, it is important to construct a series of settling curves like those of Fig. 3 and their more dilute analogues of Fig. 1 and Fig. 2. From such a set one can determine the critical concentration above which settling will take place according to the desired consolidation type. Suggestions will be obtained also concerning the degree of flocculation of the slimes, and these suggestions should be tested and supplemented by experiments on the effect of small amounts of flocculating and deflocculating agents and of such changes of concentration, temperature, stirring, etc., as may be expected to occur in practice. One will discover thus whether the slimes change degree of flocculation easily or difficultly and what consequent variations of settling are to be expected in practice. The effect of depth of tanks may be studied by settling tests made in tubes of increasing depth, extending, if necessary, to tubes as deep as the projected tanks. The difficulties of plant design will be lessened by such preliminary studies modified to suit local conditions and properly interpreted.

Considerations both of brevity and of individual and local complexity forbid the attempt to analyze other of the many important problems of settling, especially those of continuous settling now so much to the fore. The foregoing pages furnish a suggestion of the manner of attacking these problems. The promise of practical value is in the way of attack rather than in any definite theories or conclusions. Specific investigation of individual slimes is almost always a necessary preliminary.

Ontario as a Mining District

By T. F. Sutherland*

The Province of Ontario has an area of 407,262 sq.mi., of which approximately 285,000 sq.mi. is pre-Cambrian and is therefore, from a geological viewpoint, more or less favorable for occurrence of mineral deposits. It is estimated that only about 10% of that promising area has been prospected, and that not thoroughly; yet in the area so far known there were in 1915, in addition to the nonproductive properties, 79 producing mines, of which 62 operated at a profit.

The materials mined in Ontario are silver, gold, copper, nickel, iron, graphite, pyrites, talc, mica, feldspar, gypsum and corundum. The gold, silver, nickel, copper and iron are produced principally in the northern part of the province and the graphite, talc, mica, feldspar and corundum in the southeastern sections.

As regards the importance of these deposits, it is claimed that Ontario has the largest body of high-grade talc on the continent in the Cross and Wellington talc mine at Madoc; the largest body of high-grade feldspar on the continent in the Richardson mine near Verona; the greatest mica mine on the continent at Sydenham; the greatest graphite mine at Calabogie; the greatest nickel deposits in the world at Sudbury; the richest silver camp in the world at Cobalt, and the most promising of the younger gold camps on the continent at Porcupine.

The Most Important Camp in the Province

Sudbury is the greatest of Ontario mining camps yet discovered, both in size of orebodies and their value. At the beginning of 1916 Sudbury was producing at the rate of $48,000,000 in metals per year—$38,000,000 in nickel, $9,000,000 in copper and $1,000,000 in gold, silver, platinum and palladium, based on the December, 1915, prices of refined metals. Seventy-one million tons of ore is proved in the Sudbury district, and while this is called a nickel ore and is mined primarily for its nickel contents, the tonnage carries in addition two billion pounds of copper and approximately $60,000,000 in gold, silver, platinum and palladium.

The gold camps of Northern Ontario are coming to the front rapidly, and their production in 1916 should be at least $16,000,000. Forty million dollars' worth of ore is blocked out in the operating mines. During the last year promising discoveries were made at Boston Creek, at mileage 154 on the Temiskaming & Northern Onatrio Ry.; at Kowkash, 300 mi. west of Cochrane on the National Transcontinental Ry.; at Lake Wabigoon, south of Dryden on the Canadian Pacific Ry.; and in Munro township a group of claims which had been located, but idle for three years, was optioned by a Cobalt company. A prospect shaft 6x11 ft. was sunk on the vein, and from this shaft, above the 100-ft. level, $120,000 in gold was taken out in sinking operations, and in six months about $1,000,000 worth of ore was blocked out with a small prospecting outfit. The Cobalt silver area has so far produced over 230,000,000 oz. of silver, has paid about $65,000,000 in dividends, and is now mining high-grade ore at a depth of 700 ft.

Mining, like any other business, is conducted for profit, and the supreme test of the mining industry in any

*Chief inspector of mines, Toronto, Ont.

district is whether it pays or not. The value of the mineral production in refined products in Ontario in 1915 was almost $65,000,000, or more than $8 per capita of the Dominion of Canada. From the metallic-mineral production $20,000,000 was paid in dividends, or $2.50 per capita of Canada. This ratio of dividends to total production, 32½%, is probably not equaled by any other mining state or province on the continent. British Columbia, the next greatest mineral province of Canada, produced nearly $4 per capita of Canada, but the dividends paid from the metallic mineral production only amounted to about 20c. per capita of Canada.

In addition to possessing abnormally rich mineral deposits, Ontario mining camps have other advantages, among which may be mentioned the following:

The producing camps are all within a few hours' run of Toronto, the capital of the province, Porcupine, the most distant camp, being only 20 hr. distant by rail. Toronto is within a 24-hr. ride of 50,000,000 people and of the great manufacturing, marketing and money centers of the continent. The camps all have daily mail and express service, local and long-distance telephone, electric light, good automobile roads and practically all the conveniences associated with old-established manufacturing centers rather than with pioneer mining camps.

The mining centers are between latitudes 44° and 49°. The greatest elevation is about 1,200 ft. The climate is healthful and pleasant—not too hot in summer, and though cold in winter, not severe enough to curtail operations. There is no excessive rainfall or snowfall. Farming districts are immediately at or within a few miles of all camps. Contrast these conditions with camps located at high elevations in the deserts.

Power, Water and Timber Supply

The numerous lakes and rivers in the province render it practically impossible to locate a camp that will not be supplied with abundant water for power and mining purposes. During the first year or two the timber has to be cleared, and this is used for fuel. Then a water power is developed, and today 95% of the power used at the mines is hydro-electrical. At Cobalt compressed air at about 100-lb. pressure is piped to all the mines and sold to the mining companies by a power company.

A sufficient supply of suitable timber for mining purposes is available at all camps. The cost is practically that of cutting and hauling. After a camp is in operation a few years, a rail haul of a few miles is necessary. As mentioned before, this timber is used for fuel purposes during the first year or two of the camp.

There is a plentiful supply of labor at the camps, which, while not equal to the mine labor of 15 or 20 years ago, is efficient. Labor does not have to be recruited from outside points. Hiring is done on the property. The principal labor employed is Canadian and American, Finn, Russian, Austrian and Italian.

Caving, swelling or moving ground of any description is practically unknown in Ontario mines, and very little timbering is required. What timber is used is simply for convenience in mining, and not to support ground. Other conditions underground are favorable. The mines are dry; very little pumping is required, and the temperatures are normal.

A Workmen's Compensation Board, appointed by the Ontario government, collects an annual assessment on the wages, 3% for miners, and all compensation for injuries is paid for by this board. This assures the injured workman a sure and just compensation without any expense to himself and protects the companies from suits over damage claims. The fatal accident rate per 1,000 men employed was only 1.51 in 1915.

Considering all these conditions under which the mines are operated, the proportion of dividends to total production, and the vast area geologically favorable yet to be prospected, it may be said that no other country in the world offers the same inducements to capital in mining as the Province of Ontario.

Lackawanna Steel Co.

This company owns blast furnaces and steel plant at Buffalo; iron mines in Pennsylvania and Minnesota; coal mines and other property. Its report for the year 1915 shows results as follows: Gross sales and earnings, $27,792,935; other income, $344,622; total income, $28,137,557; operating expenses, $21,061,731; general expenses, taxes, etc., $1,098,357; total expenses, $22,160,088; net earnings, $5,977,469; interest, rentals and royalties, $2,044,720; sinking fund, depreciation, etc., $1,523,642; total charges, $3,568,362; surplus for the year, $2,409,107.

The net surplus for 1915 compares with a deficit of $1,652,445 in 1914. A special appropriation of $104,205 was made.

The report says in part: The company received during 1915, from mines which it owns or is interested in and from other sources, 1,727,804 gross tons of iron ore and produced a total of 844,684 gross tons of coke and 918,772 gross tons of pig iron. It also produced 122,533 gross tons of bessemer ingots and 1,040,218 gross tons of openhearth ingots, a total of 1,162,751 gross tons of steel ingots of all kinds.

Openhearth-ingot producing capacity was increased about 17% by the completion of four 70-ton furnaces. Four more furnaces of the same size are now under construction and should be in operation early in the third quarter. This will complete all authorized openhearth-ingot capacity and should permit of full operation of the company's existing mills, together with the new 8-in. and 12-in. combination bar mill which the directors authorized toward the end of 1915. This mill is expected to be in operation before the end of this year. The directors also authorized the construction at Buffalo and Lebanon of plants for the recovery from the gases of the byproduct coke ovens of benzol and its homologues. The Buffalo plant began operations in May, 1915, and the Lebanon plant in November. The results of their operation have been very satisfactory.

Orders on hand as of Dec. 31, 1915, were 812,680 gross tons, and additional sales made during 1916 should insure full operations for this year. Prices are very profitable, and the outlook for 1916 is the best in the company's history.

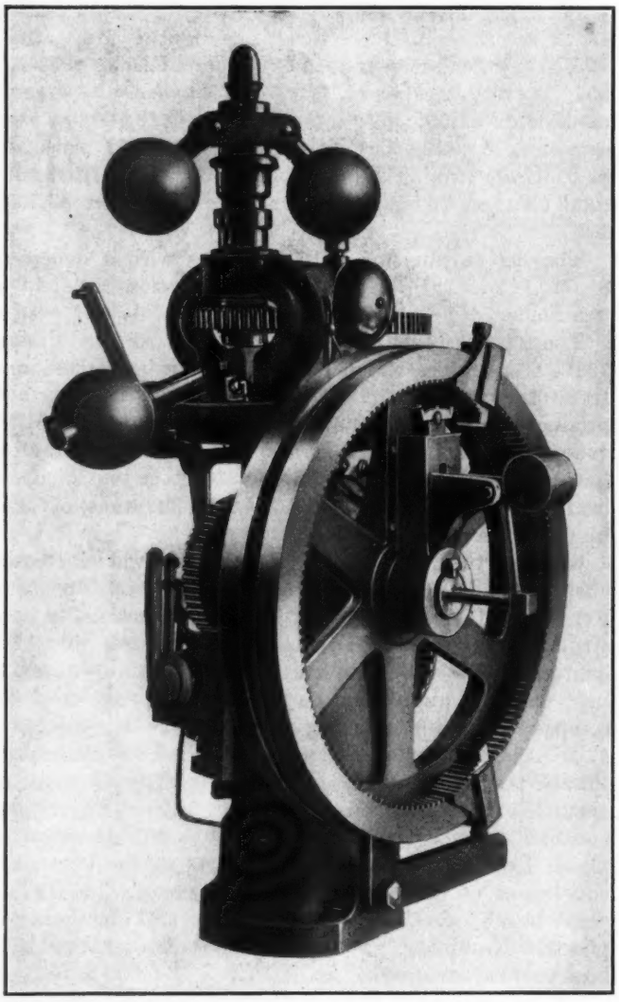
Heroult-Type Iron Furnaces, orders for 35 of which have been taken by the American Bridge Co. since last September, are required in sizes of from 1 to 20 tons capacity. Prices range from $20,000 to $40,000 each. Under present conditions of steel prices installation costs are often covered in a month or two, accounting for the great activity. Special, thin armor plate, electrically made, has brought the price up to $1 to $1.25 per lb. The steel is also used in making high-speed cutting tools.

Details of Practical Mining

Lilly Hoisting Controller

The Lilly hoisting-engine controller, shown in the illustration, is the invention of W. J. Lilly, chief mechanical engineer of the Anaconda Copper Mining Co. It is a safety device designed to prevent such accidents as are caused by improper control of hoisting engines.

Essentially, it consists of a mechanism which is connected by a chain to the indicator shaft of the hoist and



THE LILLY HOISTING CONTROLLER

which is operated by the motion of a pair of governor balls. The function of this mechanism is to trip a weighted lever, as required by circumstances, at the proper time, and thus to shut off the throttle, set the brakes and stop the engine.

In case the engineer is running the engine at too high a rate of speed, the controller will first ring a bell, then if the engine speed is not kept within the proper limits, the controller will take control of the engine out of the engineer's hands and stop it. When this occurs while the cages are running in the shaft, the speed of the hoist is reduced gradually and no sudden stop is made.

In case the cage is approaching the top or bottom of the shaft and the speed of the engine is not properly reduced, the controller will act and bring the cages to a stop at the collar or bottom landing of the shaft, as the case may be. Any wrong action of the engineer, such as would cause the cage to be pulled into the sheave or lowered into the sump, will cause the controller to set the brakes and stop the cage within safe limits.

Should any of the regular operating levers fail to act properly, the engineer can immediately stop the engine by pulling a lever connected to the controller.

When men are being hoisted, the controller will regulate the hoist at a reduced rate of speed and will prevent the engineer from hoisting men up into the skip dump.

One of these controllers has been in operation on the chippy hoist at the Leonard No. 2 shaft for over a year and a half and has proved itself a success under all possible tests. Parts sufficient to make fifty more controllers have now been received, and these will be installed as soon as they can be assembled and fitted to the hoist engines.—*The Anode.*

A Mine Cost System

By Albert E. Hall* and George C. McFeely

In all mining work it is very desirable to keep the cost of the various operations. For example, we want to know not only how much a ton of ore costs, but how much of that cost is caused by the various operations, also how much of this cost can be charged to labor and how much to supplies. In addition we want production, development, supplies and construction costs separate. For this reason some system must be evolved—the less complicated the better—such that where it involves the underground foreman he will be able to do his share intelligently and with facility. The bookkeeping and mining departments are separate divisions of the whole machine, and while the accounts do not much interest the practical miner, he must be considered in getting the correct results. The system used by the Canadian Copper Co. seems to work very smoothly. All the various departments and properties are given symbols, as are also all the numerous accounts, which are:

DEPARTMENT SYMBOLS		ACCOUNT SYMBOLS	
High Falls power plant	H	Producing labor	A
Creighton mine	K	Repairs, labor and material	B
Cream Hill mine	I	Expense accounts	E
No. 2 mine	M	Supplies, operating	C
No. 3 mine	F	Development	V
Dill quartz mine	D	Construction	X
Roast yards	R	Extraordinary repairs and improvements	Y
Smelter	S	Experiments	Z
General	G		

If we are dealing with Creighton mine, for example, and wish to show producing labor, we would mark the card or ticket or whatever we had, "KA." In the same manner we would show operating supplies as "KC."

*517 West 171st St., New York City.

This classification alone would be too abstract, and therefore these various accounts are subdivided. To show this, Creighton mine will be taken as an example.

"KA"—PRODUCING LABOR

1. Stoping: Shift bosses, level bosses, drill runners, drill helpers, scalers, blockholers, powderman and miscellaneous labor.
2. Tramming: Trammer bosses, trammers, muckers, sledgers, chute blasters and miscellaneous labor.
3. Timbering: Timbermen, masons, mason helpers, miscellaneous labor.
4. Pumping: Pumpmen.
5. Hoisting: Hoistmen, skip tenders and miscellaneous labor.
6. Crushing: Rockhouse foremen, crushermen, floormen, picker bosses, pickers, oilers, loaders and miscellaneous labor.

"KB"—REPAIRS

1. Stoping: Powder-signal system, tools, powder magazine, thawing houses.
2. Tramming: Tramcars, tracks and tools.
3. Timbering: Repairs to timbering tools, ore chutes, drywalls, chute gates.
4. Pumping: Mine pumps, water lines, pump motors and wiring.
5. Hoisting: (a) Hoists, hoisthouses, cables, pulleys, skips. (b) Lighting system, hoisting-signal system, hoist motors. (c) Shaft and appurtenances.
6. Crushing: (a) Crushers. (b) Sorting tables, screens, shafting, belting, pulleys and tools. (c) Motors and connections, electric-light wiring and fixtures. (d) Rockhouse and chutes, water lines and heating equipment.

The two foregoing accounts for Creighton will show the various divisions that are made under the subheads, and in the remainder of the accounts only the subheads will be given.

"KC"—OPERATING SUPPLIES

1. Stoping.
2. Tramming.
3. Timbering.
4. Mine pumping.
5. Hoisting.
6. Rockhouse.

"KE"—EXPENSE ACCOUNTS (Departmental).

1. Superintendent and assistant, mine surveyors and sampling men, master mechanic and assistant.
2. Clerks, timekeepers, warehousemen and other office help.
3. Printing, stationery, postage.
4. Telephone.
5. Traveling expenses.
6. Watchmen and policemen.
7. Surface improvements, streets, sewers, yards, town.
8. Maintenance and repairs to general buildings and equipment.
9. Water supply and fire protection.
10. Ventilating system, mine lighting and telephones.
20. Unclassified.

Steam

31. Producing labor.
32. Repairs.
34. Fuel.
35. Miscellaneous supplies for operating.

Electric Power

41. Producing labor.
42. Repairs.
45. Miscellaneous supplies for operating.

Electric Light

51. Producing labor.
52. Repairs.
55. Miscellaneous supplies.

Transportation

61. Producing labor.
62. Repairs.
65. Miscellaneous supplies.

Houses

71. Producing labor.
72. Repairs.
75. Miscellaneous supplies.

Air

81. Producing labor.
82. Repairs.
83. Lubricants.
85. Miscellaneous supplies.

Drill Shops

91. Producing labor.
92. Repairs.
93. Drill steel.
94. Fuel.
95. Miscellaneous supplies.

It will be noticed that in all the expense accounts the numeral in the units place always stands for the same item. In this way the system soon becomes familiar to those using it.

"KV"—DEVELOPMENT LABOR

1. Diamond drilling.
2. Shaft sinking and timbering.
3. Stations, pump sumps, ore pockets.
4. Drifts and crosscuts.
5. Raises.
6. Winzes.
7. Boxholes.

Supplies

11. Diamond drilling.
12. Shaft sinking and timbering.
13. Stations, pump sump and ore pockets.
14. Drifts and crosscuts.
15. Raises.
16. Winzes.
17. Boxholes.

"KX"—CONSTRUCTION (Labor and Material)

26. General mine equipment.
27. Dwellings and store buildings.
28. Dwellings and store buildings equipment.

"KY"—EXTRAORDINARY REPAIRS

11. Alterations to skips, skip tracks and dump, No. 2 shaft.

Other numbers are added as needed like the following:

22. Engineering and supervision of moving Bellis & Morcom compressor from No. 3 mine to Creighton.

All foremen are provided with cards, on which are listed all the men working under the foreman, that are turned in at the end of the shift. Underground foremen have two cards—one for development and one for mining. All the various classes of labor are listed on these cards, so it is a simple matter for the foreman to get his report correct, as all he has to do is to fill in the numbers of the men under the various headings. Time clocks are used for the men's pay-roll time, and thus these cards of the foreman, besides giving the correct distribution of labor to the timekeeper, serve as a check on the time of the men shown on the clocks.

Requisitions are required for all material given out at the warehouse, and these must be signed by the foreman and must show for what the material is to be used. This method, therefore, gives the proper distribution of supplies. Every day the head of each department is given a list of the material used the day before, showing to what it has been charged, which list he corrects, signs and returns to the warehouse.

From the foremen's cards the timekeepers are enabled to show all the various classes of labor and on what work employed, and from the requisition slips the warehouse clerk can show the quantity of the various materials used on each job, thus making a monthly statement possible. Each of the departments returns its results to the general office so that the statement of the whole plant can be made. To show how this can be done, a list of accounts for March, 1914, is appended. This is not filled in since the figures have no significance; neither are the items charged to the various accounts, although a statement of this sort is also made. The list simply shows the division made in the supplies and classes of labor.

Supplies—Explosives, detonators, fuses, candles, carbide, lumber and timber; steel, drills, drill parts, rolls and fastening, pipe fittings, cable, fuel oil, coal, tools, oil, waste and grease, compressor parts, hoist parts, bolts, nuts, etc., washers and rivets, rope, pump parts, black-

smith parts, crusher parts, conveyor belts, rockhouse parts, electrical supplies, belting and lacing, paint and varnish, hose, cement, clothing, construction, hoisting signal line, dump cars, conveyor parts, water puncheons, skips, miscellaneous.

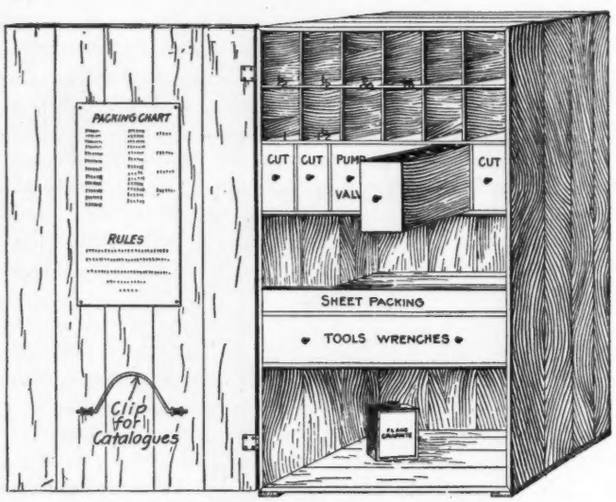
Shop Orders—Skips, tram cars, rockhouse, hoists, drill sharpeners, drills, chutes and gates, electrical repairs, pumps, crusher parts, shaft ladders, construction, house repairs, carbide lamps, signals, miscellaneous.

Labor—Superintendent and shift bosses, level bosses, drillers, drill helpers, scalers, trammers, nippers, chute blasters, powdermen, timbermen, pumpmen, miscellaneous underground, hoistmen, rockhouse, compressormen, blacksmiths, fitters, electricians, carpenters, clerks, laborers, general surface.

A Handy Packing Cabinet*

An item of prime importance in maintenance, and one to which, in many cases, engineers do not give proper attention, is packing. In this plant packing ranks third in the yearly expense bill, of course omitting labor. It is an unfortunate fact that a large percentage of the packing purchased is never used, hence the following suggestions:

Do not buy a larger quantity of any rubber goods than you are going to use in a reasonable time. Rubber is



CONTAINER FOR PACKING AND PACKING TOOLS

one of the things that age does not improve; in fact, it will be found to be very much the other way about. If the large jobbing houses cannot risk carrying an overstock, it is a sure thing that it is not safe for you to try it.

Have a proper place to keep your rubber supplies. It is not an uncommon thing to find packing kept in some old closet in which the junk odds and ends are thrown, and then to hear the engineer cuss because the packing will not stand up under high pressure.

The cupboard shown in the illustration is practical, easily made and cheap. In the upper part are the pigeonholes, in which are kept the coils of packing that are uncut. The size is marked, and if it is to be used for any particular machine a note is made on the inside of the box.

*By A. D. Palmer, Dorchester, Mass., in "Power," Jan. 4, 1916.

Below are a number of drawers in which are kept the cut packings. Each drawer is divided into a number of compartments, and the size of the packing in each is marked where it can be plainly seen. The center compartment is used to hold a number of other rubber accessories, such as pump valves, valve disks and small plumbing supplies.

A compartment is provided for the sheet packing, and nothing else should be allowed in this, otherwise the packing cannot be expected to give the best service, even when it is of the best kind and quality.

Next is the tool drawer. Here all tools are kept when not in use. This makes it unnecessary to hunt the plant over for the special wrenches, the packing hooks, etc., which are needed but sometimes hard to find.

Under this drawer is a space in which boxes of supplies can be kept. This is a good place to keep the odds and ends of packings, cans of graphite, etc.

On the inside of the door is a framed chart giving all the sizes of packings used in the plant, where used, and also particulars governing this work.

PACKING CHART

V—Valve stem. P—Piston rod.

Machine	Packing Size	Rod	Remarks
Engine No. 1	3/8	V	
	1 1/4	P	
Engine No. 2	1/4	V	
	7/8	P	
Engine No. 3	1/8	V	
	1/2	P	
Boiler feed pumps	1/4	V	
	5/8	P	
Hydraulic pumps	3/8	V	
	3/4	P	
Air compressor	1/4	V	
	7/8	P	
		Air	
Vacuum pump	1/4	V	
	1/2	P	
Ammonia compressor	1/4	V	
	7/8	P	
		Ammonia	Use rings marked "For ice machine"
Brine pump	3/8	V	
	3/4	P	
Circulating pump	1/4	V	
	5/8	P	

Under this chart on the door is a wire clip in which are kept the packing catalogs and any data that have value in regard to the packings used. One man on each watch has a key to this cupboard and is held responsible for its contents.

Finally, keep packing in a cool, dry place and keep oil away from it.

A New Mining Explosive

A new permitted explosive has been sanctioned by the Home Secretary, known as Bellite No. 1, says the London *Iron and Coal Trades Review*. Its composition is as follows:

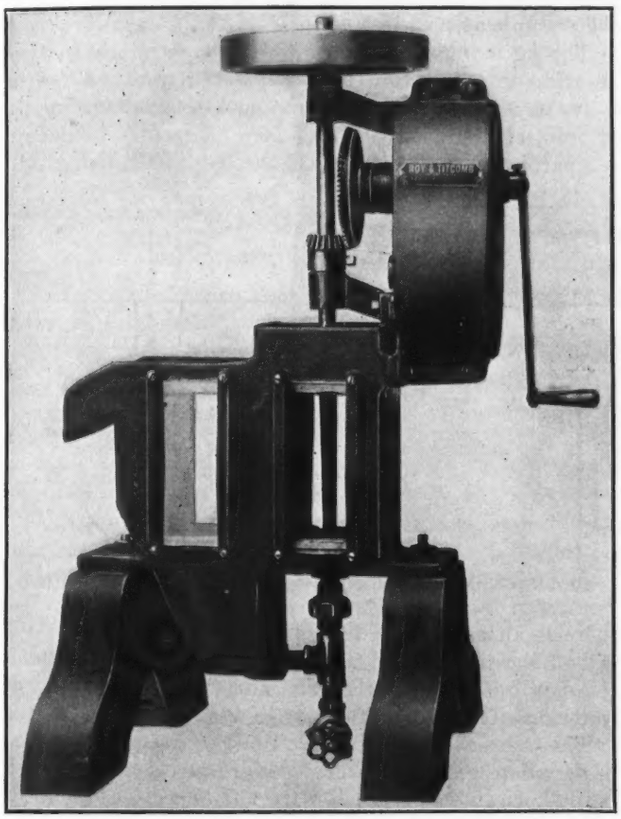
Ingredients	Parts by Weight Not More Than	Not Less Than
Nitrate of ammonium	65	62
Tri-nitro-toluol	16	14
Chloride of sodium	17.5	15.5
Starch	5.5	3.5
Moisture	2	....

It is stipulated that the explosive shall be used only when contained in a case of manila paper, fireproofed and thoroughly waterproofed with a mixture of carnauba and paraffin waxes, and that the greatest weight which may be used in any one shot hole shall not exceed 20 oz. Four ounces gave a swing of 2.74 in. to the ballistic pendulum compared with a swing of 3.27 in. given by 4 oz. of gelignite containing 60% of nitroglycerin.

Details of Milling and Smelting

Experimental Flotation Machine

A machine for making experimental flotation tests has been designed and is being made by Roy & Titcomb, Inc., of Nogales, Ariz. The illustration conveys a clear idea of what the machine is and how it operates. It is actuated



A NEW EXPERIMENTAL FLOTATION MACHINE

by hand power, and each compartment, agitation and skimming, is provided with glass sides so that progress may be watched. The machine appears to be convenient and suitable for the usual run of flotation experiments.

Truing Roll Shells by Use of Emery Bricks

By Douglas Lay*

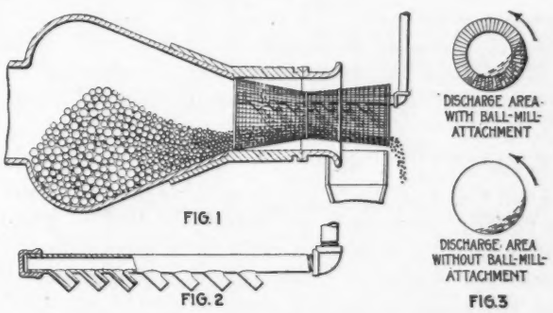
At the Van-Roi mill, in the Slocan district, British Columbia, emery bricks are used to keep down corrugations on the coarse rolls. The bricks are kept pressed against the surface of the shell by a yoke. By their use the life of the coarse shells has been at least tripled. Incidentally the emery bricks serve a useful purpose of another kind at the time of changing shells on the rolls: The roll shells are of manganese steel and are held tight on the cores by wooden wedges, in the customary way. Some hours before it is intended to change shells, water is turned off the rolls, and they are allowed to run dry. The friction produced by the emery brick causes the shell to heat up slightly and dry out the wedges, thus loosening the shells. The rolls are still crushing ore up to the time the shells are noticed to have worked loose, so that the only time lost in changing shells is that required for replacing the old shafts, cores and shells with a new set. A spare set of shafts and cores with new shells in place is always kept in readiness. The use of emery bricks entirely eliminates the usually laborious task of getting old shells off the core when wooden wedges are used for tightening.

*Mining engineer, 12 Westbourne Road, Forest Hill, London.

Rotary-Screen Ore Classifier

By Charles Spearman*

A new device the object of which is to increase the capacity of ball and tube mills was recently tried out at the Tough-Oakes mill, Kirkland Lake, on a 6-ft. Hardinge conical ball mill that was installed last year to handle 100 tons of ore per day. The ore, generally speaking, is a hard and rather tenacious reddish feldspar porphyry with gold disseminated throughout in minute joints and small quartz stringers. This ore proved comparatively refractory to disintegration by ball-mill treatment, for after a thorough test extending over a period of three months it was found that the ball mill had an average daily capacity of only 82.68 tons for total time and a maximum capacity of only 90.62 tons for actual running time, instead of 100 tons daily. Many experiments were conducted by ball-mill experts to increase the capacity of this mill during the



ROTARY SCREEN APPLIED TO CONICAL MILL

period mentioned, including increase and decrease of revolutions, load, etc., but the capacity failed to reach the prescribed figure.

Finally, the idea was conceived of a less obstructed discharge by permitting the whole product, oversize and undersize which was inclined to accumulate in the conical section of the ball mill, to pass through the conical revolving screen inserted and fastened in the discharge,

*Mining geologist and engineer, Haileybury, Ont.

as shown at Fig. 1, thereby classifying the product and returning the oversize to the feed end of the mill by means of a conveyor. This arrangement, as will be seen, permitted a much heavier load to be carried and developed consequently a greater discharge area. Later there was installed a stationary water pipe with a series of water jets arranged so as to assist the discharge of both the oversize and undersize.

After a five-months' trial of the device it was found that the capacity of the mill had been increased so as to average for that period 102.27 tons per day and for actual running time 110.41 tons per day, thus giving an increase in tonnage of 23.7% for total running time and 21.8% for actual time. The power required to operate the mill before the installation of the device was about 40 hp.; after the installation it was 35 hp., showing an actual decrease of 12.5%. By taking into consideration the increased tonnage for the actual running time, the actual decrease in power consumption per ton of ore was about 28.1%.

The device makes it possible to raise the level of the load in the ball mill without discharging the grinding medium and thus increase the load from 8,500 lb. to 11,500 lb., or about 35.3%. This feature also decreased the ball consumption from 2.45 lb. per ton to 1.8 lb. per ton. Attached to the tube mills the device permitted ready discharge and classification of oversize ore particles and undersize pebbles, which tend to accumulate and thus congest the tube-mill circuit. By its use about two tons of oversize is removed daily from the tube-mill circuit and returned to the ball-mill feed. Partly by substituting ore masses and partly by the use of the device, the pebble consumption was reduced from 16.1 lb. to 3.9 lb. per ton. The accompanying table is based on averages over a period of 3 months without and 5 months with the device.

COMPARISON OF BALL-MILL RESULTS

	Without Device	With Device	Increase, %	Decrease, %
Average mill tonnage per day, total time	82.68	102.27	23.7	....
Actual hp. required..	40.00	35.00	....	12.5
Average mill tonnage per day, actual time	90.62	110.41	21.8	....
Actual kw.-hr. per ton of ore.....	7.94	5.71	....	28.1
Ball consumption per ton of ore.....	2.45	1.80	....	26.5
Pebble consumption per ton ore.....	16.15	3.94	....	....

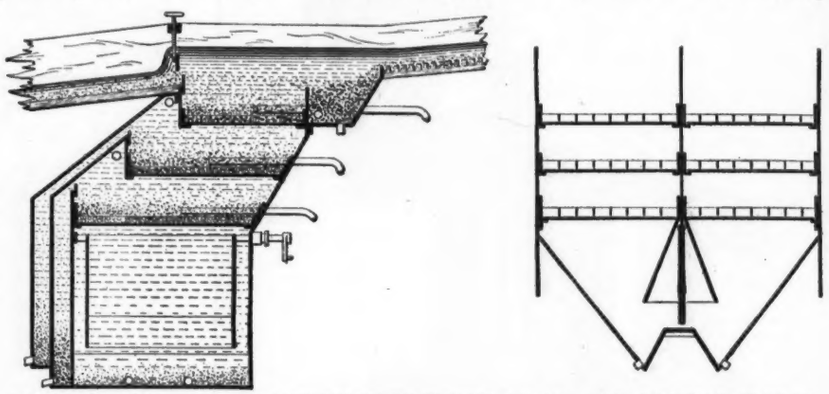
From this test the following advantages are shown for the device: It permits an increase in load of grinding medium of 35% more than could be retained with the old open-mouth discharge under normal working conditions, thus subjecting a greater area of ore to attrition; it increases the effective discharge area of the outflowing pulp, as shown in Fig. 3; it permits free discharge of the product from the conical section of the ball mill where the relatively refractory oversize particles of ore are inclined to accumulate, due to the shorter radius of action, and thus retard the discharge of the fine product; it permits a continuous classification during discharge, separating the oversize, which is returned to the feed end or zone of maximum disintegration of the ball mill (about 10% of the discharge product is classified as oversize and thus returned to the zone of greatest efficiency for further disintegration); it also decreased the ball and pebble consumption, and the cost, including maintenance, is low—about 0.00125c. per ton treated.

The preëminent feature of the device, as attached to conical ball mills, is that it solves the problem of keeping the oversize in the zone of maximum disintegration, thus adjusting the relative inefficiency of the conical section. It is the invention of C. A. Randall, superintendent of the Tough-Oakes mill, and is patented.

Steel's Jig for Gold Dredge

Donald Steel, of Palo Alto, Calif., has patented (U. S. Pat. 1,173,465) a multiple-bed jig to be used on dredges recovering gold and other metals or minerals. This machine is shown in transverse and longitudinal sections in the accompanying illustration.

The jig is provided with a preliminary trap, to prevent scouring and to afford a pocket for arresting large or heavy objects, such as amalgam, quicksilver, stones, pieces of iron, etc., and also to feed material gently to the jig compartments that follow. On the down side of the trap there is an adjustable dam, and across the sluice at the end of the jig is an adjustable gate. The dam regulates the depth of solids in the trap, and the gate the head of water maintained upon the first jig bed.



LONGITUDINAL AND TRANSVERSE SECTIONS OF JIG FOR DREDGE SLUICE

The solids collected in the preliminary trap are removed as occasion requires through a discharge hole. When desired, clear water is admitted to the various jig beds by the feed pipes shown in the longitudinal section. The intermediate and lowermost screens are inclined to prevent the feeding of too much material near the discharge side.

To make the apparatus available for service on the dredge, a pigeon-hole partition structure is provided upon each screen so that the pockets, filled with heavy pieces of punchings or other suitable material, form a jig bed that does not drift from side to side of the screens with the pitching or change of grade of the dredge. As the top screen is the smallest, the pulsations there are strongest and wash up and out some of the tailings and permit the gold and some of the heavier gangue to pass down to the next intermediate screen, where the same operation is repeated.

The longitudinal central partition of the jig is considered an improvement over partitions running across the sluice, because it allows screens of indefinite length and in case of repairs permits the entire sluice current to be diverted through one compartment temporarily.

Company Reports

Osceola Consolidated

The Osceola Consolidated Mining Co., Calumet, Mich., reports a profit of $1,610,860 for 1915 from a production of 19,731,472 lb. of copper, which it sold at an average price of 18.19c. per lb. The total receipts were $3,590,708. The expenses were $1,979,848 and consisted of mining and milling, $1,611,676; construction, $82,074; smelting, freight, selling, etc., $293,277; interest, $2,821. Dividends paid during the year were $1,057,650, leaving a balance of $2,166,646 in quick assets on hand. The following table gives comparative results for the past four years:

	1912	1913	1914	1915
Tons rock stamped...	1,246,557	735,044	1,108,447	1,361,089
Cost of mining, transportation, stamping and taxes per ton..	$1.23	$1.60	$1.29	$1.18
Pounds of mineral obtained	24,282,312	14,945,645	20,997,900	26,777,790
Pounds of refined copper	18,413,387	11,325,010	14,970,737	19,731,472
Percentage of refined copper in mineral..	75.830	75.775	71.296	73.686
Costs per Pound Copper:				
Mining, milling, transportation	8.34c.	10.39c.	9.52c.	8.17c.
Construction	0.95c.	0.77c.	0.14c.	0.41c.
Smelting, freight, selling, etc.	1.07c.	1.14c.	1.12c.	1.45c.
Total cost per pound copper	10.36c.	12.30c.	10.79c.	10.03c.
Rock hoisted, tons....	1,271,408	752,428	1,136,118	1,380,255
Rock discarded by sorting, tons	24,851	17,384	27,671	19,166
Percentage discarded..	1.955	2.31	2.436	1.389

The Osceola branch produced 272,073 tons of the rock stamped, at a cost of $1.46 per ton. This ore yielded 3,882,069 lb. of copper, or an average of 14.27 lb. per ton, at a cost of 12.34c. per lb. excluding mill construction. The North Kearsarge branch produced 7,886,579 lb. of copper from 612,831 tons of rock stamped, yielding 12.87 lb. of copper per ton at a cost of 10.99c. per lb. excluding mill construction. The cost of producing copper from the South Kearsarge Branch was 7.77c. per lb. from 476,185 tons of ore yielding 16.72 lb. of copper per ton, or a total of 7,962,824 lb. This branch of the mine had the largest production in its history. The Osceola has paid $13,237,325 in dividends up to the end of the year.

National Lead Co.

The annual report for 1915 shows dividends paid $1,705,732 on preferred and $619,662 on common stock. The surplus brought forward from 1914 was $5,352,230, making a total of $5,737,361 at the close of 1915. The report notes that the total number of stockholders as shown by the company's records on Dec. 31 was 6,788. Of this number, over 48 per cent. are women.

The president's report says in part: The company's year opened with business in diminished volume, but later on an improvement took place and an increase in volume began, which has steadily continued to the end of the year. The directors have appropriated $200,000 to create a metal reserve. The purpose of this reserve is to guard against great losses which might come to us, particularly as our operations in tin and antimony are very heavy.

It is clearly evident that a day of reckoning will surely come when values will begin to decline and in all probability decline heavily. When this occurs the directors do not wish to have the company suffer heavy losses on the large stocks of these metals which its business compels it to carry. Therefore, the company thought it prudent to create this metal reserve, set aside from profits, for the purpose of protection against the condition which sooner or later seems to be inevitable.

Copper Queen Reduction Works in 1915

The Copper Queen reduction works in 1915 treated 1,063,329 tons of new marginal material for a production of 125,144,027 lb. of copper, 1,388,149 oz. of silver and 29,840 oz. of gold. This copper production is over 5,000,000 lb. in excess of that of 1914. The total loss in copper for 1915 was 8,654,132 lb., or 6.50%, of which 1.53% is unaccounted for.

Copper Queen ores constituted about 75% of the total material treated, and custom ore amounted to about 12%. The remaining marginal material was made up of Moctezuma concentrates, 8.37%, and Copper Queen (Bisbee) slag, 4.24%. Figured on the basis of new material and secondaries treated by the plant, the total was 1,287,294 tons (coke excluded); figured on the basis of the charge smelted, the tonnage was 1,254,583, the difference in weight being due to shrinkage in roasting of 16.57%. Of the charge smelted, the blast furnaces treated 1,012,659 tons, the reverberatory furnaces 207,677, and the converters (matte excluded) 34,237 tons.

There was an average of 7.79 blast furnaces in daily operation, with an average duty of 363.5 tons each. The coke consumption was about 12.3% of the material charged. The matte fall was 18.93%, amounting to 150,431 tons of matte having an average grade of 35.06%. The flue dust produced amounted to 4.29% of the charge smelted.

An average of 11.4 roasting furnaces per day was operated with an output of 47.5 tons each of calcines. The raw material charged was 197,600 tons, from which 164,849 tons of roast was produced. In the reverberatory department an average of 1.68 furnaces per day was operated, smelting 338.7 tons each. This was 42.4 tons more per furnace-day than in 1914. The material smelted comprised 149,511 tons of calcines, 14,903 of raw ore, 42,984 of flue dust, 214 of barren quartz and 65 tons of secondaries.

The converters treated 201,611 tons of matte for an average daily production of 32.6 tons of bullion per stand, an average of 5.3 stands being operated. There were also smelted in the converters 32,226 tons of siliceous ores, 1,170 tons of slimes, 40 tons of barren silica and 801 tons of clay.

In the laboratory 111,268 determinations were made, of which 101,743 were for the reduction department.

Reduction costs were slightly higher in 1915 than previously because of the irregularity of receipt of ore from Nacozari, the rise in price of copper and the straining for maximum production.

The cost of power in 1915 was slightly higher than during the previous year, largely owing to the fact that fuel oil cost 8c. per bbl. more. In the main boiler plant 87,440 bbl. of oil was burned, and in the reverberatory plant 165,669, of which 57,040 bbl., or 34.43% was charged to steam production. The cost per horsepower-year for the entire plant figured $60.44, and the average horsepower developed was 4,507.5 per day. A new cooling system was installed in the power plant, this being charged to operating.

There were two fatal accidents during the year, one involving permanent disability, 36 serious and 149 minor accidents. The average number of employees in the smelting department was 965, as compared with 946 in 1914 and 1,040 during the previous year.

Old Dominion Copper

The Old Dominion Copper Mining and Smelting Co., Globe, Ariz., for 1915 reports a profit of $1,337,086 from the production of 27,736,158 lb. of refined copper, 150,621 oz. of silver and 2,937 oz. of gold, including custom ores. Of this production 13,771,681 lb. of copper, 40,632 oz. of silver and 620 oz. of gold came from Old Dominion ores and 13,964,477 lb. of copper, 109,988 oz. of silver and 2,316 oz. of gold from custom ores. The average price received for copper was 18.61c. per lb. and for silver, 49.59c. per oz. Total receipts from the sale of metals were $2,595,431 and smelting profits on custom ores and miscellaneous income amounted to $259,415, making total receipts $2,854,846. Total expenses were $1,517,760. Dividends totaled $810,000 for the year. Depreciation amounting to $572,351 on plants and $195,023 on mines was charged off surplus account and not included in the expenses stated. A balance of $1,223,332 in quick assets was on hand at the close of the year. The following table gives a comparison of tonnages and grades of ore for 1914 and 1915:

	Dry Tons, 1915	Extracted, 1914	Average Grade, 1915	% Cu, 1914
Smelting ore	80,512	99,507	7.81	8.28
Concentrating ore	32,380	30,159	3.72	4.69
Siliceous ore	2,567	147	3.65	3.12
Total	115,459	129,813	6.56	7.44

Mining costs in 1915 were $5.51 per ton, compared with $5.20 per ton in 1914. Development work consisted of sinking, 334 ft.; drifting, 6,937 ft.; raising, 2,614 ft.; intermediate work, 4,456 ft.; total 14,341 ft., compared with 15,665 ft. in 1914. It is stated that the cost of power was $70.81 per hp.-yr., compared with $68.81 in 1914. The increase in power costs is accounted for by the price of fuel being higher in 1915 and by the fact that there was a considerable increase in the quantity used on account of providing more power for mine pumps. There was a total of 2,769.4 million gallons of water pumped from the mine. Of this amount 730 million gallons was sold to the Miami Copper Co. The minimum rate of flow was 5,360,147 gal. per 24 hr. on Oct. 28, and the maximum flow was 14,492,923 gal. per 24 hr. on Mar. 26. The cost of concentrating was $1.215 per ton, compared with 93.2c. in 1914. The increase in cost was caused by heavy repair work and flotation expense. The total mill recovery was 85.27%, compared with 73.55% for the previous year. The grade of ores treated by the concentrator for 1914 and 1915 is given in the following table:

	1915 Dry Tons	1915 % Cu	1914 Dry Tons	1914 % Cu
Company ore	32,560	3.72	30,101	4.69
Custom ore	140,486	4.48	121,792	4.67
Total and average	173,046	4.34	151,893	4.67

The smelting cost was $2.755 per ton for 206,549 tons of charge smelted, against $2.669 for 207,595 tons smelted in 1914. The increase was due to labor, repairs and flux costs. Coke costs decreased 6c. per ton of charge. The converting costs and production compare as follows:

	1915	1914
Cost of converting per ton fine copper	$5.36	$5.65
Pounds blister copper produced	27,960,091	30,448,901
Pounds fine copper produced	27,736,158	30,210,361

The decrease in converting costs was accomplished largely on account of the repair items, notwithstanding the fact that there was 2,500,000 lb. less copper handled than during the previous year. The converter shell that was blown in on June 27, 1913, came off the stand for an initial patching on Dec. 7, 1915, having been on the stand for over 30 months, during which time it produced 70,860,000 lb. of bullion. The lining costs per ton for this shell were 5.5c. per ton of bullion. The best lining cost under the old acid-type practice was $1.80 per ton of bullion. The cost per pound of refined copper at Globe after deducting gold and silver values and profit from smelting custom ores and miscellaneous profits was 7.29c.; other expenses for refining, selling, taxes and Boston office amounted to 1.61c. per lb., making the total net cost 8.9c. per lb. of refined copper.

Elkton Consolidated

The Elkton Consolidated Mining and Milling Co., Cripple Creek, Colo., for 1915 reports a production of 16,528 dry tons of ore averaging $18.42 per ton, as compared with an average of $18.37, $18.38 and $19.01 for 1914, 1913 and 1912 respectively. In addition to the ore produced by the company, 43 leasers produced 20,420 dry tons averaging $9.53 per ton. Of these leasers 13 operated at a profit.

The known ore reserves above the 16th level were largely depleted, and dividends have been suspended until development work opens up more ore below this level. The Roosevelt Drainage Tunnel has now reached a heading about 150 ft. below the bottom of the Elkton shaft, and the water has receded far enough to permit the shaft to be sunk to 125 ft. below the 16th level. A station will be cut at this point, and drifting will then be started. The Arequa lease on the Raven & Beacon Hill Mining Co.'s property, operated by the company, shows a slight loss for the year. The following table gives the production, average value and freight and treatment charges:

	Dry Tons Ore	Average Gross Value per Ton	Freight and Treatment per Ton	Average Net Value per Ton
Leasers, mine ore	16,510	$8.17	$4.23	$3.94
Leasers, dump ore	3,910	15.24	5.13	10.11
Total leasers	20,420	$9.53	$4.40	$5.13
Elkton mine	16,528	$18.42	$5.63	$12.79
B. & H. lease	155	13.28	5.00	8.28
Entire property	36,103	$13.50	$4.95	$8.55

Tramming costs at the Elkton amounted to 11.25c. per mine car and at the R. & B. H. Lease, 28.5c. per car. About 55% of the rock broken on the Elkton was waste, and the labor cost for breaking ore was 66c. per ton and for waste, $1.50 per ton. The average cost for labor breaking ore and waste was 79.3c. per ton. Powder cost was 22c. per ton of ore and waste broken. Sorting cost 21c. per ton. Contract development work was done at the following rates: Drifting, $4, $6 and $6.50 per ft.; sinking winze $11.50 per ft. Cost of company work on development is shown in the following table:

	Feet	Labor per Ft.	Powder per Ft.	Powder and Labor per Ft.
Sinking Elkton shaft.....	150.5	$11.35	2.65	$14.00
Sinking Elkton winze.....	207	8.03	1.52	9.55
Raising, Elkton	175	3.49	1.21	4.70
Drifting, Elkton	2,939	2.61	1.37	3.98
Drifting, R. & B. H. lease.	176	3.06	0.84	3.90

The average cost of sharpening hand and machine steel was 2.5c. per piece. The average wage per shift, including shift bosses, was $3.53 at the Elkton and $3.44 at the R. & B. H. lease. The average wage for the entire mine, including office and superintendent, was $3.68 per shift. Receipts from the sale of ore aggregated $498,753. Mining expenses were 36.3% of the gross receipts from the sale of the ore; maintenance, 2.4%; depreciation, 5.5%; shipping and selling, 42%; general expenses, 6.9%. Earnings from mine operations amounted to $32,968. Miscellaneous receipts totaled $446. Dividends for the year amounted to $100,000. The company ended the year with a cash balance of only $3,697 and current accounts receivable aggregating $6,555. Current accounts payable totaled $15,950, and $7,477 of taxes had accrued.

Copper Queen Mines in 1915

The Copper Queen mines in 1915 produced 783,211 tons of ore exclusive of 46,965 tons of slag from the old dump and 601 tons of copper precipitates recovered from the mine waters; over 23,000 tons of lead ore, containing approximately 8,800,000 lb. of lead, was also obtained from the mine, some of which was concentrated and the remainder shipped to El Paso.

The average grade of the copper ore mined from the limestone division was about 6%. In this division of the mine 68,431 ft. of development was done during the year, and the ore reserves stood at 2,696,940 tons, approximately the same as at the beginning of the year. In the disseminated area of Sacramento Hill 42,952 ft. of churn-drill holes brought up the reserves—assuming a 1.3% Cu minimum—to 8,542,836 tons averaging 2.732% Cu; if the minimum be assumed as 1%, the reserve may be calculated at 11,633,481 tons averaging 2.455% Cu. Notwithstanding the extension of the Sacramento Hill orebody, there remains much unexplored ground. Tests on a working scale in an experimental mill have demonstrated that 1.3% of copper will be profitable, and it is possible that 1% material can be worked. A recovery of 85.45% of the copper was made in a test of 4,407 tons of ore averaging 2.96% Cu; the ratio of concentration was 3.24:1.

The methods of mining have not changed, except in the proportional quantities mined by different systems. The replacement of the square-set method of mining by top-slicing and the cut-and-fill method wherever possible has reduced the mining cost. According to the report of Gerald Sherman, superintendent of the mining department, the percentage of ore mined by the different systems in 1915 was as follows: Square-set, 65.9%; top-slicing, 18.7%; cut-and-fill, 15.2%; shrinkage, 0.2%. In 1913 the proportion of ore mined by the square-set method was 88.1%.

The working conditions in the three divisions of the mines where forced ventilation has been introduced have demonstrated that better ventilation and lower temperature have been elements in the reduction of the cost of mining. The average number of employees in the mining department was 1,883. On Feb. 1, 1915, a sliding scale providing for increase in wages for each advance in the price of copper above 15c. was made effective. Salaried men, including shift bosses, foremen and office employees, received a 7½% increase on May 1, 1915, such increase to be in effect while the price of copper remains at 16c. or more.

United Globe Mines

The United Globe Mines, Globe, Ariz., in its report for 1915 shows a profit of $812,251 before deducting $5,508 for depreciation of plants. Dividend payments amounted to $621,000, making a total of $2,576,000 in dividends to date. There was a balance of $271,000 in quick assets at the end of the year. The following table gives a comparison of tonnages and grades of ore for the last two years:

	Dry Tons		% Cu	
	1915	1914	1915	1914
Smelting oxide ore	19,112	14,352	6.90	6.38
Smelting sulphide ore	292	12,639	1.01	1.69
Concentrating ore	119,537	121,812	3.63	3.23
Silica converter lining.....	2,299	6,402	4.73	7.44
Total	141,240	155,205	4.08	3.57

All the 141,240 tons of ore produced was shipped to the Old Dominion Copper Mining and Smelting Co. The metal production from this ore was 11,536,021 lb. of fine copper, 105,109 oz. of silver and 1,508 oz of gold. Development work consisted of 63 ft. of shafts, 6,295 ft. of drifts, 1,801 ft. of raises and 852 ft. of intermediates; total 9,011 ft. The costs at Globe for mining, pumping, development and other expenses at the mine were $624,574, or about $4.44 per ton of ore.

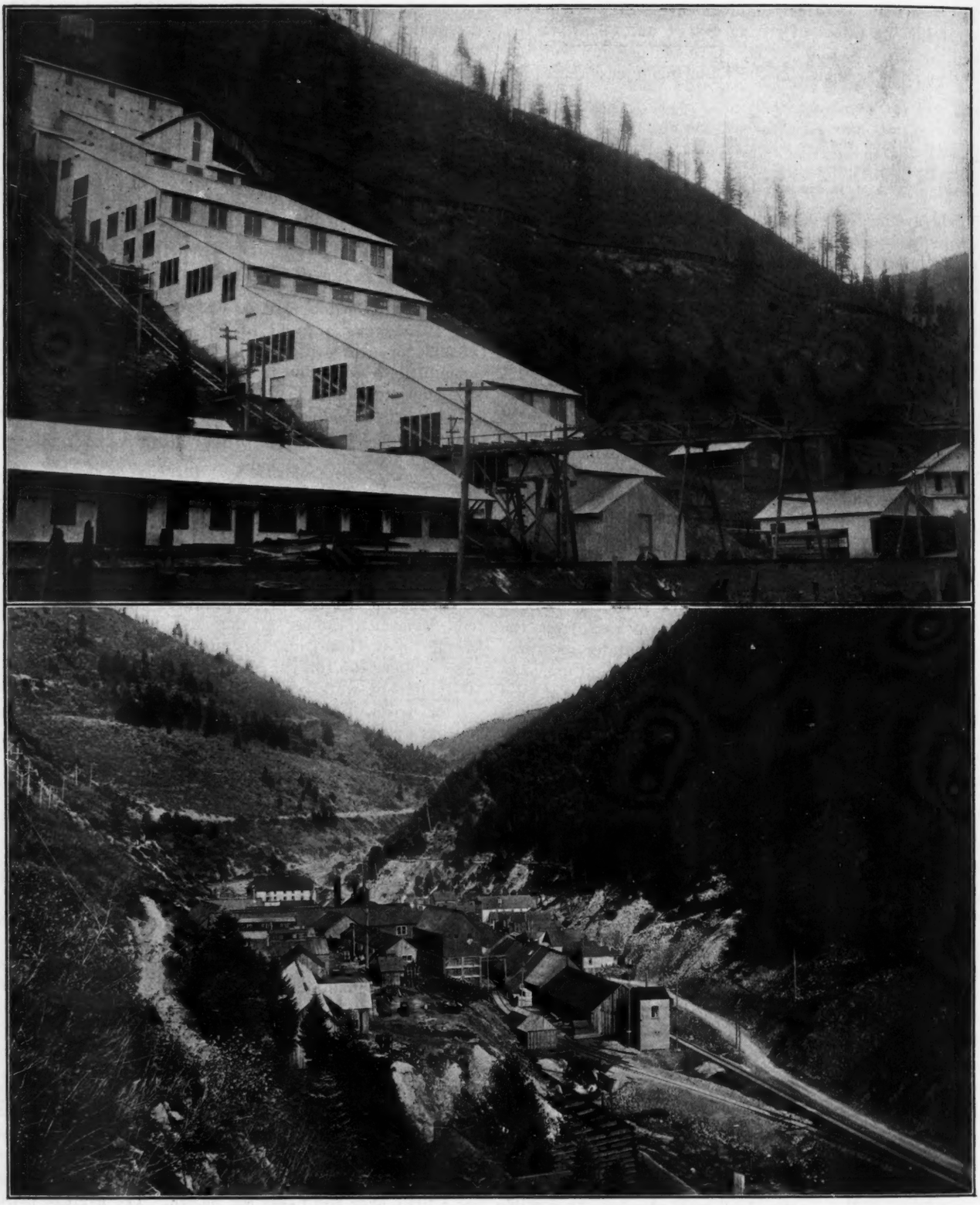
New Idria Quicksilver

The report of the New Idria Quicksilver Mining Co. for the year 1915 shows the net proceeds from sales of quicksilver to be $405,991; quicksilver on hand Jan. 1, 1916, $98,850. The decrease in supplies amounted to $1,168; interest receipts amounted to $2,315. Total expenses, including all repairs, construction and development work, amounted to $346,959. The net profit for the year 1915 was $159,028. Dividends Nos. 124 and 125, amounting to $150,000, were paid. Operations for the last two years were as follows:

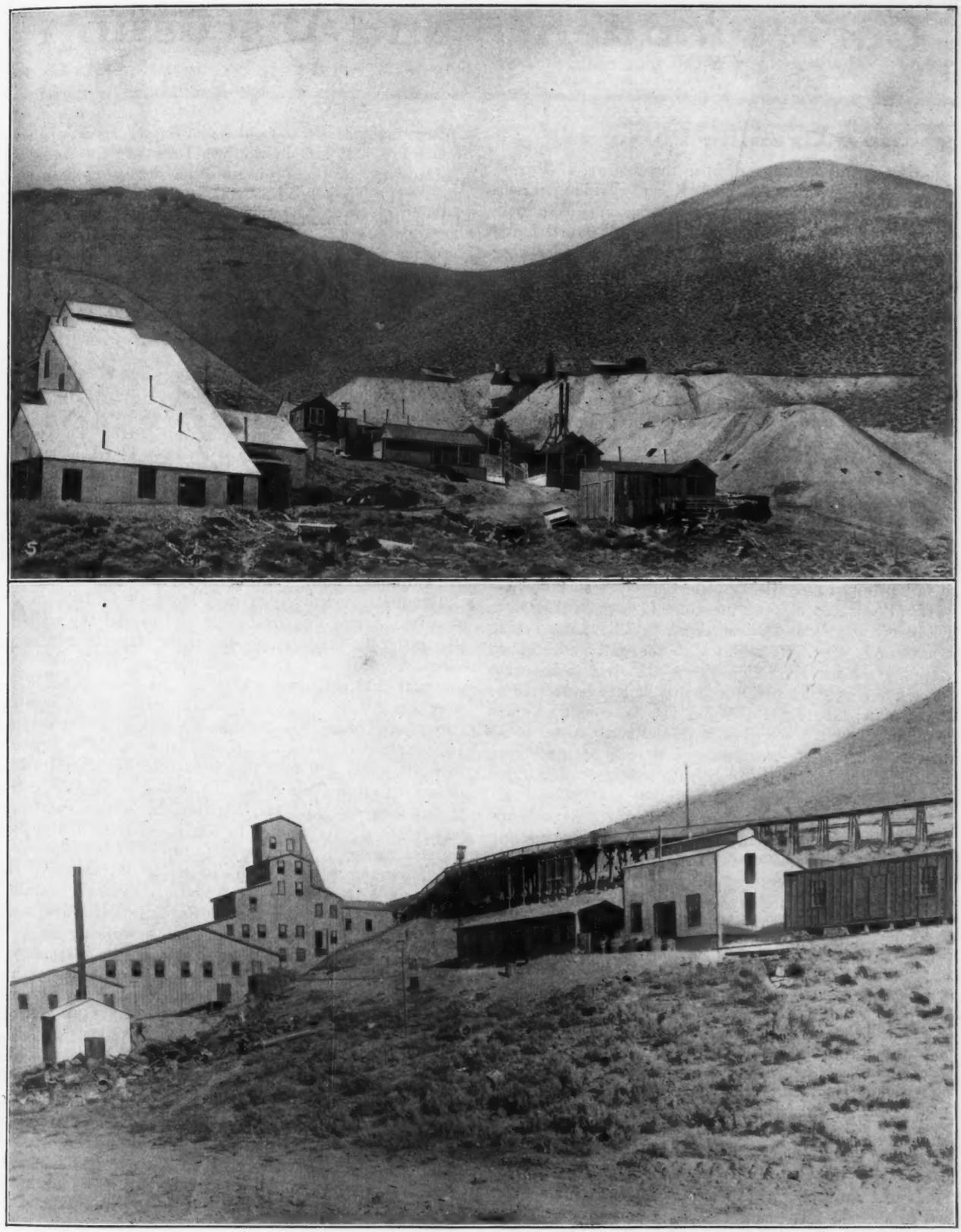
	1914	1915
Tons of ore reduced.....	62,578	66,538
Flasks quicksilver produced.....	6,550	6,250
Drifts and tunnels run (ft.).....	12,367	10,842

All three furnaces were run continuously during the year, and although the grade of the ore mined was lower than heretofore, the production was steadily maintained at a little over 500 flasks per month. The average price received for quicksilver during the year was about $74.

Photographs from the Field



CONCENTRATOR OF THE NATIONAL COPPER CO. AT MULLAN, IDAHO, A FLOTATION PLANT. BELOW IS SURFACE PLANT AT THE GREEN-HILL-CLEVELAND TUNNEL, MACE, IDAHO



VIEWS OF TWO INTERESTING MILLS IN THE ROCHESTER DISTRICT OF NEVADA

The upper photograph is of the Seven Troughs Coalition Co.'s plant, which in 1915 produced $416,084 from 4,509 tons of ore; average about $93 per ton. The lower photograph shows the mill of the Rochester Mines Co.'s 10 stamps, crushing 125 tons per day and producing about $2,000 of bullion daily

Correspondence and Discussion

Slow Cyanide Poisoning

Acting upon your suggestion in the *Journal* of Mar. 4, 1916, regarding cases of sickness due to cyanide poinsoning, I am glad to supply some information. While in charge of the Taracol cyanide plant of the Oriental Consolidated Mining Co., in Chosen, a direct-leaching plant treating upward of 2,000 tons of concentrates per month, I was knocked out for two weeks with a sickness that might have proved fatal but for a good doctor.

I had not had a day of sickness for over 12 years when this trouble laid me low for two weeks. It was in the winter, with the thermometer below zero and the big cyanide plant housed and warmed in order to keep running. We used a strong solution—about 0.65—and the cyanogen escaping from the leaching tanks was always noticeable. I observed first a lax feeling, with headaches and some dizziness, and shortly had to go to bed and send for the doctor.

Dr. J. W. Nolan (God bless him!) went over me carefully and knew what to do and did it. Doctor Joe is one of those natural born physicians, and I never knew him to fail in any case. He described my case to me afterward (I was too sick at the time to care much) as a disease of the gall, and whenever my "gall" is not working I am surely sick. It seems that the gall had stopped dropping the necessary liquid onto the liver to keep the latter going in good shape, and this had to be started or I was a dead one. "Doc" told me the scientific name of the bug, but it bounced off my head and escaped somewhere. When "Doc" cut loose with one of those long monikers, one had to be ready with a large bag to catch it in and then tie it down securely.

I was sick and sleepless for nearly three days before the agitation process commenced again in my interior. After that I recovered rapidly. It all came on by being closely confined to the cyanide plant and breathing and absorbing the gas into my system. None of the other employees was ever troubled this way, but I think it was because they did not confine themselves as closely to the plant as I did.

This was a case of slow poisoning no doubt, and I remember one thing, Doctor Joe advised was to eat plenty of sweet things, such as candy, as this would relieve the condition caused by the gas. I have noticed that men working in cyanide plants crave sweets. My shift was long; being short-handed, I had to be on the job 12 hr. I do not think this would hurt anyone on an 8-hr. shift.

In my experience I have known men to break out with skin eruptions when going to work in a cyanide plant, but this is always quick, and they are the ones who must change their occupation. About 10% are so affected. It seems that slow poisoning affects us differently. In John R. Janes' case it affected the nervous system and in my case the organic. I remember that I was very nervous, though, along with it. I think any good doctor would recognize the ailment if it was described, and could treat it. Dr. Joe Nolan did not answer my last letter, and I have lost track of him. But if this hits him in the eye, I am sure he would be glad to give to the profession the details used on my case. "Doc" is a good sport and fees are not his main aim in life, which is to cure. Strength to his arm!

J. D. HUBBARD.

Lucky John Mine, Paradise, Calif., Mar. 12, 1916.

Blast-Furnace Tapping by Electricity

I notice that in the *Journal* of Apr. 1 you give a description of a method of tapping that is almost the same as that in use at the smeltery of the Teziutlan Copper Co. at La Aurora, Puebla, Mexico, in July, 1913. The copper in the ores of that company is associated with about 2½ times as much zinc or, say, 4% Cu and 10% Zn. The run-of-mine ore was smelted raw in blast furnaces of large size (4½x20 ft. at tuyeres) in front of which was a settler 18 ft. diameter and 4½ ft. deep. The settler was lined in the usual manner with 13½ in. of firebrick and had two matte taps.

The matte usually contained from 10 to 15% of Zn as sulphide, and this segregated and caused the walls of the settler to thicken and the matte taps to get hard. When we dug out frozen settlers, we frequently got material that contained 45% Zn. As a consequence we were obliged to feed back matte with the charge to increase the matte flow through the settler, and it became an established practice to blow matte in the converters to white metal and feed that back into the blast furnace in order to thin the walls of the settler so that the matte tap could be opened. The length of the furnace campaign was frequently terminated by our inability to drill a hole through the settler walls so as to tap out the matte.

I have known these walls to get so thick that a bar driven in 5 ft. would not tap matte. Before I installed the electric tapping, I frequently had the entire force of the blacksmith and machine shops working on both matte taps, trying to put in a hole before matte overflowed with the slag and began to shoot in the slag granulator. It was a strenuous business, and we were all worn out hammering on bars and drills. A queer thing about it was that we could frequently drive a bar in that we could not pull out. The zinc sulphide in the matte attacked the steel bar and made a collar on the end of it which was larger than the hole. In these cases we would try, and sometimes succeed, in driving the bar in about a foot or more quickly so that the collar would melt off before another one was formed and then put our best hammermen on in relays, and pull it out quickly if it did not break off. In case it broke off and left a plug in the hole, we sometimes succeeded in driving this plug in and then pulled the driving bar. So many kinds of trouble developed along with the revolution that it is impossible to recall all that we did or tried to do, but we were so constantly in terror lest the matte tap freeze up that the

sound of the hammers going for a long time at night was signal enough to cause the sleeper to walk—usually to the works.

That old saying that necessity is the mother of invention was true in this case, and I found that by means of an old 110-volt lighting transformer, I could step-down the 5,000-volt current from the power house to a safe limit. Accordingly, I had A. B. Stewart, chief electrician (who was afterward all through the Dardanelles campaign and is now on the Island of Lemnos) install old trolley wire leads from the transformer to the blast furnace. One wire was grounded on the settler shell, and the other terminated in a flexible cable attached to a wooden handle and a copper clamp for holding the end of the cable and the carbon-rod electrode. The current was switched on the open circuit at the transformer, and a man took the wooden handle and held the 1-in. carbon electrode against the tap hole. A flash announced the contact, and white fumes of zinc began to develop. The fused material was raked out of the hole with a scraper when it began to interfere with the progress of the carbon electrode. Usually the hole could be melted out in 15 to 20 min. with the minimum of exertion.

The first trial was made on the night shift, and I well remember the broad smiles and pleased countenances of the Mexican furnace crew when the hole was burned through without a blow from a hammer. Mr. Stewart handled the electrode, and I had thought it necessary for him to instruct one of his electricians how to do it so that he would not have to be called out at night when the matte tap froze. You can appreciate my surprise to find the Mexican furnaceman doing the job equally well the following night. Like the tramp of the soap ad, we used no other thereafter.

When the revolutionists forced us to return to the United States in October, 1913, I went to the office of the metallurgist of the Steel Corporation and to his chief assistant I told what I had done with electric tapping and suggested that it might be of use in tapping blast furnaces. I was told that they had used it and also that they got better results from the oxyacetylene blow lamp. I therefore never attempted to do anything further with it, thinking it old. Your announcing it as new is a surprise to me.

HIRAM W. HIXON.

Philadelphia, Penn., Apr. 1, 1916.

The Hoisting-Rope Question

The article about hoisting ropes in the *Journal* of Dec. 4, 1915, asks for the safety factor in hoisting ropes and the stresses that should be considered in calculating these safety factors. I have had some experience with wire rope, and the facts I have ascertained may be of use to the profession.

By selecting a piece of the end of a hoisting rope, capping it and sending it to the government mine inspector for test every six months, which is done at this mine, 23 years of experience has shown me that there is no safety factor that may be taken without reserve. Many ropes increase their breaking stress considerably near the end when made in compound and ordinary lay. Whether this same increase of breaking strength takes place elsewhere in the wire rope would be interesting to know, but rather expensive to find out. In the part of ropes where the most severe wear takes place, either in straight incline shafts or in compound shafts, crystallization and corrosion occur where the rope encounters the most strain and weight at the point where there is no play; that is to say, 12 to 15 ft. from the skip or cage and 100 ft. up the rope. If the engine will allow a few hundred feet of extra rope, so that 60 to 90 ft. can be cut off every six months, according to the work the hoist has to do, it will be beneficial; and then if, later, the rope is turned end for end, the life will be doubled.

With a high-speed winding engine on a conical-drum hoist, for instance, pulling from 2,000 to 3,000 ft. per min., there is no other safety factor than watching the ropes daily while in use. I maintain that lubrication to high-speed winding rope is as important as oil to the bearings of a hoisting engine. For ropes used on conical drums I find that midway of the length of rope in use is the danger point and needs watching. Perhaps it might be interesting to give a history of some of the ropes I have had under my care. I will take four 2-in. diameter winding ropes that I have recently changed in a seven-compartment shaft.

1. The winding rope of No. 6 compartment hoisted 2,749 million ft.-tons in 1 yr. 7 mo. The rope was turned end for end and put on another hoist, No. 2 compartment, and there hoisted 3,236 million ft.-tons in 1 yr. 10 mo. 26 days. The total work done was 5,985 million ft.-tons in 3 yr. 6 mo. 4 days. The total broken wires when discarded were about 2,000; the size of the rope at the middle was $1\frac{5}{8}$ in. in diameter.

2. The winding rope in No. 7 compartment hoisted 2,626 million ft.-tons in 1 yr. 6 mo. 25 days. It was then turned end for end, put on another hoist at No. 3 compartment and did 3,303 million ft.-tons in 1 yr. 11 mo. 9 days. The total work done at both compartments was 5,936 million ft.-tons in 3 yr. 6 mo. 3 days. The total broken wires when discarded were 68; the size of the rope in the middle was $1\frac{3}{16}$ in. in diameter.

3. The winding rope in No. 3 compartment did 2,346 million ft.-tons and was then turned end for end and put on another hoist in No. 6 compartment, and there performed 4,454 million tons of work. The total work done was 6,800 million ft.-tons in 2 yr. 11 mo. 23 days. The total broken wires when discarded were 165, and the size of the rope was $1\frac{9}{16}$ in. in diameter.

4. This rope in No. 2 compartment did 2,287 million ft.-tons and was then turned end for end, put in the No. 7 compartment and there did 4,843 million ft.-tons. The total work of the rope was 7,130 million ft.-tons in 3 yr. 1 mo. 6 days. The total broken wires when discarded were 1,353, and the size of the rope was $1\frac{3}{4}$ in. full, in diameter.

All four ropes were 3,500 ft. long, 2 in. in diameter, 6x31 wires, made triple-compound in ordinary lay; breaking strength from 185 to 195 tons.

So far as I can see, the best measure of safety is careful watching of the rope, the condition of its wires and corrosion. Hot lubrication should be used often, since it will cost less to keep off internal friction and corrosion and also prevent crystallization to some extent. There are various ways of applying this lubricant without too much trouble, and it always pays.

C. M. RASMUSSEN.

Crown Mines, Johannesburg, South Africa,
Feb. 24, 1916.

Editorials

Beware the Metric-System Movement!

An insidious and dangerous attempt to foist the metric system upon the United States is now being made. The opponents of this, having defeated previous attempts, have let themselves be lulled into a feeling of security, and the present movement gained headway without attracting their notice. It has gone so far that there is now pending in Congress a bill making the metric system *compulsory* in the United States within a few years.

The advocates of the adoption of the metric system are in the main scientists and theorists who think of the simplicity of decimal notation and the interchangeability of measures of length, volume and weight, and the desirability of uniformity among the nations of the world. Among industrialists there are also supporters of it. In the main they are persons whose business relates especially to measures of weight. If the measures of weight were the only thing, there would be no insuperable difficulty in changing gradually to the metric system. There would be much trouble in doing it, but probably it would not lead to disaster.

With regard to measures of length conditions are quite different. With these are directly related our standards, our drawings, our patterns and our gages—the accumulation of centuries of manufacturing industry. If they had to be thrown away, there would be nothing less than chaos. That is why American manufacturers are almost a unit against the adoption of the metric system. The case is lucidly stated in a recent communication by Henry R. Towne, himself one of the most distinguished manufacturers, as follows:

> Decimal notation and the metric system are two distinct propositions, although very commonly confounded. The convenience of the metric system of weights and measures, especially in scientific work and in complex calculations, is largely due to its use of decimal notation, but still more to the interrelation of its units of length, volume and weight, whereas our present system lacks this latter admirable quality and permits of decimal notation only to a limited degree. On the other hand, for all the ordinary transactions of daily life, not the decimal but the binary system of division is in universal use, even in metric countries, and always will be, for the human mind naturally divides things into halves, quarters, etc., not into tenths, hundredths, etc. Even in France today the unit of weight for domestic purposes is the livre (= one-half kilogram), and this is divided into half-livres, quarter-livres, etc.
>
> No one denies the unfortunate complexity of our present system or its lack of coördination between the units of length, volume and weight, but neither can anyone deny that we now have that great desideratum which led France (and later Germany) to adopt the metric system, namely, uniformity—uniformity not only throughout our own country, but also practically throughout the British Empire. Said John Quincy Adams in his ever memorable report of 1821 on this subject: "Is your object uniformity? Then, before you change any part of your system, such as it is, compare the uniformity that you must lose with the uniformity that you may gain by the alteration."
>
> To change our units of volume and weight might not be extremely difficult, for they are used chiefly in transactions relating to the present and the future, but to change our units of length (and area) would impose a vast burden of expense on all our mechanical industries and involve them in a chaos of difficulties for generations to come, because measures of length "are linked irrevocably to the past" and are embedded in our structures, machines, products and science. In France, after 115 years, some of the old units of length still persist, and as late as 1906 an official decree was issued forbidding their continued use.

There was no great difficulty in introducing the metric system in Mexico 20 years ago. Mexico was not then a manufacturing country to any considerable extent. Its business made most use of measures of weight and volume. The use of measures of length related mainly to the present. It made no great difference to the person buying drygoods if he bought in terms of the *vara* on one day and the meter on the next. It would have been just the same if the new measure had been the ell. But if the manufacturer of the cloth had to discard all of his patterns, gages, etc., it would have been a very serious matter.

France was able to adopt the metric system about 115 years ago, her industries not then having attained a high degree of development. At the present time France could not easily change her system. The adoption of the metric system in Great Britain and her colonies would have had to have been about 200 years ago, if at all. As for the United States, the change was seriously considered nearly 100 years ago and even then was rejected on the basis of the memorable report of John Quincy Adams.

The reason against the adoption of the metric system in the United States now is generalized in the broad statement that our "measures of length are linked irrevocably with the past and are embedded in our structures, machines, products and science." A compulsory change would be now nothing less than an industrial calamity.

The Committee of Standards of the American Institute of Electrical Engineers has called a conference to consider this question. It is to be hoped that the mining and metallurgical industry will be adequately represented in that conference.

A Mining Accomplishment in Mexico

One of the anachronisms of recent and present conditions in Mexico, as far as operations of the mining profession are concerned, is well illustrated in the costs given in the article entitled "Concreting the Barron Shaft in Pachuca" elsewhere in this issue. Ordinarily, abnormal and difficult conditions greatly increase the cost of any construction or operation, but strangely enough, in this instance the reverse was true. Rates of exchange, and therefore the cost in Mexican currency of all things from labor to rock, fluctuated rapidly during the period, but owing to the disrepute into which Mexican currency had fallen, the work cost only a little more than half what it would have cost in peace time.

The versatility of the mining engineer is shown again in this piece of work. The shaft was squeezing and, in order to be saved, had to be concreted at once; the country

was torn by civil warfare, and was cut off from communication with the surrounding world by railroad, telegraph or telephone. Whereupon the mining engineers promptly stole a railroad train, ran it, under circumstances of extreme danger, to an abandoned cement factory, hastily loaded several cars of cement and safely transported them to the shaft collar, after which they resumed their normal rôle of peaceful mining engineers and carried out the work to its successful conclusion.

The Railway Congestion

During the last six months the domestic industry of the United States has become seriously hampered by the inability of the railways to move freight promptly. The superficial explanation of this is the war. Without any doubt the transportation of large quantities of material destined for export, the congestion in the seaports owing to shortage of ocean-carrying capacity and the increase in purely domestic business stimulated by the profits realized in foreign business have all played a part in this. These things appear, however, to fall a good deal short of a complete explanation. It may be conjectured that if there had been a natural revival in peaceful business, without any stimulus from military orders, we should have been in somewhat the same situation.

At the present time railroad earnings—both gross and net—are the largest in the history of the country. Many roads are blocked with freight, others are short of cars. The transportation machine is creaking. Manufacturers and merchants find their profits curtailed because they cannot get their goods to market. In the more developed regions of the East automobile trucking over the highways is being extensively employed. Such use is being made of means for transportation by water as never before. In some cases freight service by trolley lines has been instituted. This follows a period during which railway building practically ceased. In 1915 there was less new railway construction than in any year since the Civil War.

What then is the reason for this? Manifestly, the carrying capacity of American railways has not in recent years been increased in proportion to the growth in population and the demands to be made upon it. And wherefore? Obviously for the reason that the railways have not been able to offer such terms as to induce the investing public to furnish them with the necessary money. The railways have been so hampered with restrictions—national and state—and have been so squeezed between limitations as to rates on the one hand and the demands of the labor unions and tax gatherers on the other hand that they have ceased to be attractive to investors, who prefer to put their money into other things. To this condition have we been brought by the anti-corporation, anti-railway legislation of the last two decades. The logical outcome of it all is but just becoming apparent.

Of course the railways will do everything they can to get the most possible out of their existing plant. In spite of the great efficiency with which they are operated, there is undoubtedly much room yet for improvement. The grand strategy is finely conceived, trainloads have been increased in a marvelous way; but in tactics, in the management of details, there is a good deal that can be improved. This is evident from the recent work of the Eastern Freight Accumulation Conference, composed of Interstate Commerce Commissioner E. E. Clark and the executives of the Eastern railways. The subcommittee on freight accumulation sent out 21 inspectors in New England and New York Harbor territory. Through the efforts of this committee the situation in New England has been materially improved and much of the New Haven territory opened up for business already under load and held up on account of embargo. A reduction in the total number of cars on the New Haven system and reclaimed against the New Haven was effected in less than three weeks to the extent of 11,260 cars. This naturally relieved the whole situation and incidentally resulted in a saving of $5,067 daily in per diem charges on cars, to the New Haven.

The inspectors sent into New England examined 42 principal points. They made exhaustive examinations into conditions at these points with the result that they were able to suggest improvements in methods.

Important as such things are, however, they do not correct the main trouble, namely, that the railway capacity, in densely populated parts of the United States at least, is insufficient, and steps are not being taken to increase it and cannot be until railways are put on the investment basis that will induce the public to buy their new securities. With the impending new demands of labor it seems likely that there will have to be a Federal fixation of wages as well as of rates, and there must be such a margin as will permit the railways to compete for capital, else they will not get it. With the termination of the war it is certain that there is going to be a great competition for capital.

The gist of the whole thing is that the people cannot have service without paying for it. If they will not pay the railways for transportation what they ought to, they may have to tax themselves to build and repair highways to carry their goods by automobile. As between such alternatives it would be much the cheaper to pay the railways to carry on the business in the way they have been doing.

Utah To Build Leaching Plant

A few years ago the talk was all of the new hydrometallurgy of copper. Anaconda committed itself to such a program on an immense scale, but at the eleventh hour switched to the flotation process. There was a similar switch at Inspiration and elsewhere, but no one else was so far ahead as Anaconda. The result was the installation of a plant at Anaconda—a large one, but only a fraction of what had been contemplated—and a further prosecution of work by New Cornelia, which is now erecting a plant. In general, however, the new hydrometallurgy of copper was regarded as having died in infancy, and attention was concentrated on the marvels of flotation.

As often happens, however, conclusions were drawn prematurely. Attention is directed to this by the official report of the Utah Copper Co., just published, that it is going to build a leaching plant of 2,000 to 3,000 tons' daily capacity this year to treat the oxidized capping that is being removed from its orebodies. Adding this to the Anaconda and New Cornelia plants, the hydrometallurgy of copper will be pretty well represented in American practice.

BY THE WAY

Here is a frank ad. at any rate:

TO THOSE INTERESTED IN MINING VENTURES

Dreamer of energy with experience in mining prospecting in various lands wishes to form an exploration syndicate, and get into private correspondence with those with money willing to take a flyer into the unknown.

Apply "Imagination," care "The South Pacific Mail."

A modest celebration in Washington last week marked the 100th anniversary of the establishment of the United States Coast and Geodetic Survey. The anniversary almost escaped notice, but it was a notable one in reality, for it marked the centennial of the first scientific department of the Federal Government. The Coast Survey has never been prominently before the public, but its representatives have the satisfaction of looking back on a hundred years of exceedingly useful work quietly and efficiently performed.

One of the largest chemical and metallurgical companies engaged in the manufacture of war munitions started erection of a plant, speed of construction being the only desideratum. Several months later the engineer in charge was asked for detailed costs. Up a stump only for a minute, the versatile engineer took a copy of Gillette's "Construction Costs," multiplied a set of figures by 1.5, sent the statement in, and everybody was happy ever after. Nevertheless there was somebody asleep on the job somewhere.

Sir George Paish, the distinguished British economist, said recently that before the war England had a total income of $12,000,000,000 from 46,000,000 persons, 20,000,000 of them employed; she had accumulated wealth of $105,000,000,000 and had $20,000,000,000 invested abroad. Since the war, her income has risen by $3,000,000,000 annually, although 4,000,000 men have been withdrawn from industry; $2,500,000,000 has been called in from abroad and the nation's debt is now $12,000,000,000, against $3,535,000,000 before the war; with another 12 months of war it may be $20,000,000,000. But trade income has responded so well that 1917 will find a better financial situation than 1913.

"Web of Steel" (Fleming H. Revell Co.), by Cyrus Townsend Brady in collaboration with his son (of the same name), is an engineering novel whereof the theme is the construction and collapse of a great cantilever bridge, like the Quebec bridge, which fell during building a few years ago. The technical part of this romance is truer than it is given to most novelists (save Kipling) to achieve, and the framing of the story is really dramatic, but it is told with an ineptness and dullness that soon weary the reader. Why some competent novelist does not arise to weave romances about subjects of engineering and mining is one of the mysteries of literature.

However, our art has found a real story-teller in E. Nelson Fell, a mining engineer well-known in this country, whose last important engagement was as general manager of the Spassky mine and works in Siberia. Mr. Fell, who is now living in retirement in the South, is contributing to the *Atlantic Monthly* a series of sketches of experiences with the Kirghiz in that region where the Spassky is. His literary work is characterized by humor and style. Here at last we have a mining engineer who can write in such a way. His story of "A Copper Kettle" is rich. Once on a time his smelters struck, demanding one dollar a day instead of 25 cents. The manager endeavored to persuade them to go back to work, keep the furnaces going, and talk the matter over at leisure, but the men declared that that would be impossible seeing that they were on strike. However, they requested an order so that they should have credit on their wagebooks wherewith to buy tallow and tea.

"We don't want much credit. Just enough to last us while we are on strike."

"You know you are talking nonsense; go back to your people and tell them to go to work."

"The Bai knows best, but our people will be very disappointed when they hear the Bai will neither raise our pay nor give us credit at the store."

They left; but it was not very long before they appeared again.

"Bai," they said, "perhaps we asked for too much when we asked for one dollar a day; we will be satisfied with 50 cents a day."

Refused, they went away, but returned later to say:

"Bai, it is very unfortunate and very awkward that during a strike we can get nothing to eat."

Then they abandoned their demand for higher wages and requested better coal for their fires, next improvement of their quarters. The manager refused everything, saying that he would give them nothing until all went back to work. They were quite dejected when they left and quickly returned.

"At least," they said, "the Bai will grant us this request. Our copper kettle is quite worn out; will the Bai give us an order for a new kettle?"

It was impossible to maintain a consistent and stern attitude toward such helpless and amiable people. The long-planned strike had come down to a request for a copper kettle. The order was signed, and showed to the manager in triumph.

"You have won your strike, have you not?" said he.

"Yes, Bai, we are now going back to work."

Less successful is a writer in a recent number of the *Saturday Evening Post,* who found his theme and his scenery in the Joplin zinc-mining district and among the smelteries of Kansas. There ought to be a lot of good stories in that interesting region. The *S.E.P.* story-teller may have been there for local color, spending a day or two, or he may only have purchased a guidebook and a set of photographs somewhere else. However, we incline toward the former hypothesis inasmuch as there are some remarks respecting the smelting works that indicate observation on the ground. The scenario is then developed in good old *S.E.P.* style, but its requirements involve a conception of industrial conditions that might have occurred to Alice in Wonderland, but hardly to anybody else except the ingenious author. Nevertheless it is a rattling good story, in which the villain is laid low and the hero wins the heroine and becomes a millionaire and everything turns out as it ought to in the *Saturday Evening Post.*

The Metric System Again--Take Warning!

The following are excerpts from an editorial in the *American Machinist* of Mar. 30:

The most dangerous and insidious of all attempts to foist the metric system on this country is now under way. Doctor Stratton, director of the National Bureau of Standards, has prepared a "Report to the International High Commission Relative to the Use of the Metric System in Export Trade." This report has been prepared at the request of Secretary McAdoo for the International High Commission which convenes in Buenos Aires, Apr. 3, next, for which Secretary McAdoo is at this writing en route; and all signs point toward its use before the commission in order to commit our Government to the adoption of the system.

In this devious and roundabout way it is sought to undo the great work accomplished by manufacturing interests a dozen years ago in defeating the bill for the compulsory adoption of the metric system then before the House Committee on Coinage, Weights and Measures. It must be remembered that that work is now ancient history and practically forgotten in Washington. The personnel of Congress has largely changed, the administration has changed more than once, and meanwhile Doctor Stratton has been constantly on the ground and ceaselessly active in poisoning our public officials with his specious assumptions.

The report is expressly announced as intended for wide circulation. It is a Senate document, which means that, to the resources of the Bureau of Standards, Doctor Stratton has now annexed the facilities of the Government Printing Office and, through the franking privilege, the use of the postal service in spreading his metric propaganda—and all without cost. It is the object of Doctor Stratton's life to force the metric system upon this country; and much as we condemn, we cannot but admire, his ingenuity in enlisting the Government departments in his service. It is plain that since the victory of a dozen years ago manufacturing interests have been asleep, and on them Doctor Stratton has stolen a march. Much as we deplore the re-introduction of a subject of which all—and none more than we—are heartily tired, it is plain that another and united effort must be made to nullify the activities of the most dangerous enemy of our industries which our country harbors.

In its issue of Apr. 6 the *American Machinist* returns to the subject as follows:

Too late for insertion in our last week's issue, we learned of the introduction in Congress of a bill for the compulsory use of the metric system. Read Section 4. The "Congressional Record" has the following:

Mr. Dillon introduced in the House of Representatives on Dec. 6, 1915, the following bill, which was referred to the Committee on Coinage, Weights and Measures and ordered to be printed:

A BILL

to establish the metric system as the standard for weights and measures and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the weights and measures of the metric system shall be the sole standard of weights and measures in the United States on and after July 1, 1920: Provided, That in the meantime such metric system shall be permissive.

Sec. 2. That all equivalents between the units of the metric system and the system now in common use throughout the United States shall be calculated from the fundamental relation, one meter being equivalent to 39.37 inches and one kilogram being equivalent to 2.204622 avoirdupois pounds.

Sec. 3. That the director of the Bureau of Standards, with the approval of the Secretary of Commerce, shall prescribe rules and regulations for carrying out the provisions of this act, and shall prepare and promulgate tables based upon the fundamental relation established in section 2 showing the equivalents of the weights and measures of the metric system to those of the system in customary use in the United States.

Sec. 4. That any person, corporation, company, society or association who shall use or offer and attempt to use, in any industrial or commercial transaction in the sale or purchase of any commodity, any other weights and measures than those of the metric system on and after July 1, 1924, shall be guilty of a misdemeanor, and upon conviction thereof in any court of competent jurisdiction shall be punished by a fine of not more than $500 or by imprisonment for not more than three months, or by both such fine and imprisonment.

One does not need the gift of second sight to recognize the connection between this bill and the plan for committing the Government to the adoption of the system through the action of the Joint High Commission on Uniform Law now in session at Buenos Aires. Full particulars of this scheme were given in our editorial of last week.

The following is our interpretation of this connection, which we submit to the judgment of our readers:

1. The pro-metric party had this bill introduced early in order to give time to work on the Committee on Coinage, Weights and Measures through hearings or, more probably, by lobbying with individual members.

2. It expects to secure action at Buenos Aires committing this Government to the adoption of the metric system.

3. It expects to have the committee convinced of its wisdom and to have the bill reported to the House of Representatives at the opportune moment.

4. This opportune moment will arrive when Secretary McAdoo returns from the meeting of the Joint High Commission with resolutions committing the participating governments to the metric system.

5. It then expects to rush the bill through Congress with a hurrah and as an act of good faith with the South American republics.

According to an article in "Munsey's Magazine" for April, Doctor Stratton has already secured the favorable impression of the committee.

Read Section 4!

The matter is discussed in our own editorial columns this week.

Inspiration Consolidated*

Copper production began at Inspiration in June last. The first unit of the new mill went into operation on June 29. The first ore was caved underground and actual mining started July 25. During the last six months of the year additional units of the mill were put into service as fast as they reached completion. By the end of December, 12 units out of the total of 18 were in use. At the end of January, 17 sections were completed, and during February the last one went into service. The copper production for the period was as follows: July, 1,095,909 lb.; August, 2,189,425; September, 2,746,066; October, 4,017,604; November, 4,855,526; December, 5,541,140; total, 20,445,670. The tons of ore concentrated for the six months were 778,851.

	Copper, %
Assay of ore milled	1.702
Oxide copper in ore	0.226
Assay of tailings	0.373
Oxide copper in tailings	0.180
Assay of concentrates from flotation	37.630
Assay of concentrates from tables	13.120
Average assay of concentrates—total made	32.670
Average recovery of total copper in ores milled	79.950
Average recovery on sulphide copper in ores milled	88.560

To produce one ton of concentrates 24.6 tons of ore was required.

The ore treated all came from underground work except 7,858 tons reclaimed from the Joe Bush and Scorpion dumps. The net copper deliverable by the smelting company derived from the ores treated during the six months' period July 1 to Dec. 31, was as follows:

	Lb.
From concentrating ores	20,067,310
From oxide ore sent direct to smelter	378,360
Total	20,445,670

The cost of copper derived from concentrating ores was:

	Cost per Lb.	Cost per Ton Ore
Mining	2.664c.	$0.68110
Coarse crushing	0.113	.02910
Ore hauling	0.079	.02025
Concentrating and royalty	1.889	.48675
Concentrate hauling	0.006	.00160
	4.731c.	$1.21880
Smelting, freight, refining, marketing, etc.	3.455	.76420
	8.136c.	$1.9830
	20,067,310 lb.	778,851 tons

The mining cost per ton of ore above includes a charge of 20c., which it is calculated will cover the

*Report of General Manager C. E. Mills to the president and directors and included in the company's annual report for 1915.

average amount of drifts, raises and haulageways required per ton of ore mined. The cost of the 378,360 lb. copper from crude ores sold was 7.65c., making an average cost for all copper produced of 8.132c. per pound.

During the year 1915 the underground work preparatory to mining was extended as follows:

Lineal Feet	Haulage-ways	Ordinary Sized Drifts	Main Raises	Finger Raises	Shafts	Misc.	Total
During 1915..	1,322	24,623	36,455	47,146	....	....	109,546
Total to Dec. 31, 1915	...40,184	119,809	122,469	47,146	6,386	1,136	337,130

At this date, while the construction work is not yet complete, the plans have so far matured that both the mine and mill have each exceeded a daily tonnage of 14,000 and are now operating regularly at a figure slightly below that. The tonnage rate in the mill for February was 12,300 per day, and for the first 15 days of the current month 13,600 per day. The copper production for February was 8,300,000 lb.

The important elements of the Inspiration program as decided upon early in 1913 were the mining system described in a previous report and the adoption of flotation for concentration of the ores.

An important feature of the mining equipment is the large size of the underground ore pockets at the shafts, holding 3,700 tons. They were designed to render mining and underground ore haulage reasonably independent of hoisting and coarse-crushing at surface.

Other equipment items of considerable interest but of relatively minor commercial importance are: The air-haulage system underground; the automatic skip loading and automatically controlled ore hoisting device; and the Marcy ball mills at the concentrator. These machines grind ore of 1½ in. cube maximum size to pass a 48-mesh screen—an unusually great reduction for a single machine.

Just now, the plant output having reached the anticipated capacity, the whole program may be considered as undergoing a preliminary tryout.

The Mining System Employed

With the mining system there has been demonstrated the possibility of making a large output with a relatively small working force and at a low cost. There is the inevitable dilution of the ore by waste or low-grade ore, which goes with every caving system. It remains to be determined whether this dilution is greater in ours than in other caving systems. There is a loss of good ore also, all of which was anticipated and of which you were advised in our report of three years ago. The present system was adopted with plentiful anticipations of its drawbacks, but with the belief that the maximum of profit on such ore grades as ours would be attained by its use.

In the report of a year ago it was stated that the test-mill operations to that date showed a saving of copper present in the ore as a sulphide of 86.7% and that we might count on doing that well in the new mill. The operation of the new mill for the last six months of 1915 showed a saving of 88.56% of copper present in the ore as a sulphide. During much of this period the flotation units were overloaded because the grinding units came into service faster than the flotation units were completed and the loads on the flotation units in service were temporarily doubled up in consequence. For February this year the sulphide copper saving was 91.1%.

The saving of 88.56% of sulphide copper in the new mill for the last six months of 1915 was on an ore that averaged 1.702% total copper, of which 0.226% was in oxide combination. We apparently saved about 24% of this oxide copper, and the resulting average saving of total copper contents of the ore milled in the new mill was 79.95%. Thus:

	% Cu Saving
Sulphide copper in ore.....	1.476 × 88.56% = 1.3071%
Oxide copper in ore.....	0.226 × 23.7 % = 0.0536%
Total copper in ore.....	1.702 × 79.95% = 1.3607%

Since August, 1914, in the test mill and later in the new mill, we have continued to use coal tar as the chief component in our frothing mixture. It has seemed the most efficient agent, and it is also the cheapest. During this time we have not experienced the violent fluctuations in recoveries we feared and which we previously had with some other frothing agents.

The test mill ran from Jan. 3, 1914, to June 30, 1915, and treated 257,272 tons of ore. From the latter date until Feb. 8, 1916, it operated as a temporary unit in our general concentrating process when it was closed down, having treated 373,705 tons in total. Contrary to the usual experience this test mill paid the cost of its construction, its operating expense, the present average mining cost on ores treated and something besides, and has been written off the books. Through its operation the experimental department was able to get necessary information on many subjects and furnish the mechanical department with the flow sheet finally embodied in the new mill, which mill, while of exceedingly large tonnage for the floor area covered, is yet only a very simple 800-ton mill repeated 17 times, since each unit is substantially independent in itself and similar to its fellows.

Three years prior to the starting of production at Inspiration roughly 100,000,000 tons of ore, 75,000,000 of which was sulphide, had been developed by churn drilling. A comparatively negligible amount of underground work was done. To prepare and equip the property for the mining and concentration of 5,000,000 tons of sulphide ore per annum—roughly 14,400 tons daily capacity—an expenditure as follows may be set down:

	Cost per Ton of Daily Capacity
Equipment of mine and mill, including water-supply, power, mill sites, tailings lands, railroads, etc.	$625
Advanced mining expenditures to prepare for an output of 14,400 tons per day.....	208
	$833

The advanced payments for mining will appear at the proper time in the mining costs.

A considerable part of the plant-equipment expenditures will last the life of the mine. Improved metallurgy will doubtless justify replacements of other parts. The oxide ores will probably call for a treatment method of their own.

The operating costs at Inspiration for mining and milling will probably be from $1 to $1.15 per ton of ore, possibly nearer the former figure. While a yield of more than 20 lb. per ton of ore can be obtained from much of the ore, a better mining practice can be followed and more ultimate profits obtained by mining ore producing 20 lb. on the average.

NEW PUBLICATIONS

GEOLOGICAL SURVEY OF QUEENSLAND: Index No. 5 to Publications Nos. 215 to 226. (Vol. III of New Series.) By Russell Dixon. Pp. 52. Geological Survey of Queensland, Brisbane.

GEOLOGY AND MINERAL RESOURCES OF THE STANTHORPE BALLANDEAN AND WALLANGARRA DISTRICTS, SOUTHERN QUEENSLAND, 1913; With Notes on the Silver Spur Mine, Texas. By E. Cecil Saint-Smith. Pp. 165, illus. Queensland Geological Survey, Brisbane.

MINING INDUSTRY OF IDAHO FOR 1915: Seventeenth Annual Report. Pp. 134, illus. Robert N. Bell, State Mine Inspector, Boise, Idaho.

U. S. STANDARD TABLES FOR PETROLEUM OILS. Circular No. 57, of the Bureau of Standards. Pp. 64. illus.; 15c. Department of Commerce, Washington, D. C.

SUMMARY REPORT OF THE MINES BRANCH OF THE DEPARTMENT OF MINES FOR 1914. Sessional Paper No. 26a. Pp. 238, illus.; 25c. Canadian Department of Mines, Ottawa.

SOME ENGINEERING PROBLEMS OF THE PANAMA CANAL IN THEIR RELATION TO GEOLOGY AND TOPOGRAPHY. By Donald F. MacDonald. Pp. 88, illus. Bull. 86, U. S. Bureau of Mines, Washington, D. C.

THE FLOTATION PROCESS. Edited by T. A. Rickard. 6x9, pp. 364, illus.; $2. Mining and Scientific Press, San Francisco, Calif.

Reprint of articles original and otherwise, that have appeared in the "Mining and Scientific Press" in 1915 and early part of 1916.

ANNUAIRE POUR L'AN 1916, PUBLIÉ PAR LE BUREAU DES LONGITUDES. 3¾x6, pp. 657, illus., paper; 1.50 fr. Gauthier-Villars et Cie, Paris.

This is the customary edition of the French nautical almanac, which also contains tables of solubility, electrochemical equivalents, atomic weights, etc., in addition to its astronomical data.

MODERN CHEMISTRY AND ITS WONDERS. A Popular Account of Some of the More Remarkable Recent Advances in Chemical Science for General Readers. By Geoffrey Martin. 5x7½, pp. 351, illus.; $2. D. Van Nostrand Co., New York

This is an interesting book of popular character, but in parts we fear it is beyond the depth of the class of readers to whom it is directed.

DANA'S SYSTEM OF MINERALOGY: Third Appendix to the Sixth Edition, Completing the Work to 1915. By William E. Ford. 6¾x9¾, pp. 87, illus.; $1.50. John Wiley & Sons, Inc., New York.

During the six years that have elapsed since the last appendix to this monumental work, 182 mineral names have been proposed by investigators in mineralogy. Of these minerals which have received new names, about one-third are apparently well-established cases. This does not cover all of the work of investigation in this field, much of which has been interrupted by the European War. The most important single new development in mineralogical investigation during this period covered by the index has been the use of the X-ray as a means of studying the molecular structure of crystals. Only a beginning has been made in this direction, but results already achieved show that much may be expected in the future from this method. In general the appendix follows closely the precedent established by the two previous issues and brings the "System of Mineralogy" thoroughly up to date.

THE MINING MANUAL AND MINING YEAR BOOK FOR 1916. By Walter R. Skinner. 5¼x8¼; pp. 970, illus.; 15s. Published by the author, 11 Clements Lane, London, E. C.

The present volume is the thirtieth consecutive yearly issue of this well-known work. The high standard is continued, and it remains the most valuable work of its kind. No material changes are noted of size, or otherwise. The alphabetical arrangement adopted last year has met with approval, as being the handiest form for quick reference, and it has of course been continued. At the same time the index has not been abandoned, as it has been found very useful for cross references. The supplementary index, which lists the names of those companies that have ceased to be of public interest or are dormant, is in the present volume placed at the end of the book, instead of next to the regular index. This avoids confusion and is a good change. The dictionary of mining terms and alphabetical lists of mining directors, secretaries, engineers and mine managers, with their addresses, continue to be valuable features of the work.

MILITARY PREPAREDNESS AND THE ENGINEER. By Ernest F. Robinson. 4x6½, pp. 224, illus.; $1.50. Clark Book Co., Inc., New York.

The author of this book is a practicing engineer, is a captain in the Corps of Engineers in the National Guard of the State of New York.

The book itself is a decided innovation. It is pocket size and contains a wealth of information in a most readable form, which will interest any engineer and will enable him to read the current war news with much more intelligent interest. There is no other publication of its size that touches on so many different phases of the military problem, and it carefully avoids the dull routine that is found in many military publications. It has a particularly illuminating chapter on trenches and trench warfare.

For the man who does not intend to undertake military service, this book is a readable story on the most important theme of the day; to the man who does intend to undertake military service, this book furnishes a fine foundation, and in it he will find lists and specific directions for obtaining government and other military publications on the subject, which will go into the detail of any arm of the service.

INFORME PRELIMINAR SOBRE LAS RIQUEZAS MINERALES DE LA REPUBLICA ORIENTAL DEL URUGUAY. (Preliminary Report on the Mineral Resources of Uruguay.) By Rolf Marstrander. Pp. 87, illus. Bull. No. 2, Instituto de Geologia y Perforaciones, Ministerio de Industrias, Montevideo, Uruguay.

This preliminary report gives information regarding the little known mineral resources of Uruguay. The report is accompanied by a preliminary map and is made especially available to English and American readers by having its text printed in English as well as in Spanish. The mining development has been principally in mineral products such as marble, granite, slate and talc, of which Uruguay possesses supplies of excellent quality. Desultory metal mining has been done and there are known deposits of iron, manganese, copper, lead, gold, bismuth and mercury. Other mineral resources, as yet not much developed, include graphite, asbestos, emery, coal, peat, oil shales and semi-precious gem stones.

THE METALLURGISTS AND CHEMISTS' HANDBOOK. A Reference Book of Tables and Data for the Student and Metallurgist. Compiled by Donald M. Liddell. 4x6½, pp. 603, illus., leather; $4. McGraw-Hill Book Co., Inc., New York.

This is a very useful pocket book that every chemist and metallurgist, and many other people also, ought to have. There are many kinds of pocket-books. Most of those who have attempted such compilations have succeeded only in producing tabloid treatises. The real pocket-book, in our view, is a collection of tables and data that people need to refer to, and not much else. Mr. Liddell seems to have caught the pocket-book idea better than most have done. This is evident from his preface where he says that his book is but little more than a collection of tables. It is not a great work. It does not go into a large number of things that ought to be taken up in a work of this sort that is aimed to be comprehensive. But so far as it goes it is excellent, and without any doubt is the best pocket-book for chemists and metallurgists that there is at present. The sections on physical constants and chemical data are especially strong and leave but little to be desired. Some of the chapters relating to metallurgical practice are less comprehensive. However, the book as a whole is one that is to be well recommended.

MINES AND MINERAL RESOURCES OF COUNTIES OF CALIFORNIA FOR 1913-1914. First 5 chapters. Pp. 859, illus. Biennial Report, State Mineralogist, San Francisco.

These chapters form a part of the biennial report of Fletcher Hamilton, state mineralogist. The remaining chapters to complete the report will follow as soon as the field work and the compilations of the data are completed. In dividing the report into chapters, each chapter containing the record of a group of counties, the publication is made not only more convenient for the library and the desk than the former bulky volumes containing the complete record of all the counties, but it also provides the metal producers and others interested in the mineral reports of the state with the records and data brought nearer up to the date of publication than was possible by the old form.

The five chapters issued contain records of the following groups of counties: (a) Del Norte, Humboldt, Mendocino; (b) Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo; (c) Shasta, Siskiyou, Trinity; (d) Amador, Calaveras, Tuolumne; (e) Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus—25 of the 58 counties in the state. The chapters contain tabulated statistics and are illustrated with maps, diagrammatic sketches and photographs. In the record of each county the mineral substances produced and the names of the mines are given in alphabetical order.

The Mining Bureau has published a number of valuable bulletins in the past 10 years, but has not issued a general report since the thirteenth biennial in 1896. So the mining public has been for the past 20 years without a complete record of mining properties in California. The chief reason assigned for failure to issue such reports by recent predecessors of Mr. Hamilton is a lack of sufficient appropriation by the legislature. The present state mineralogist has been more fortunate in securing recognition of the legislature and money for the proper conduct of the bureau.

PERSONALS

S. F. Shaw is visiting the Nevada Consolidated property at McGill, Nev.

W. de L. Benedict left New York for California Apr. 11, to be absent until June.

Leo Von Rosenberg recently visited the Ray and the Prescott districts, in Arizona.

William Crosley, formerly in Mexico, is now manager of the Prestea Block A, Ltd., in the Gold Coast Colony, West Africa.

G. A. Joslin has left the employment of the Ray Consolidated Copper Co. and is now in Kansas City on professional business.

Dr. L. D. Ricketts, who has been in South America, arrived in New York on Apr. 8. B. B. Thayer will be home in about three weeks.

A. H. Brown, manager of the Dome Lake Mines Co., Porcupine District, Ont., has resigned. His present address is at No. 133 Kent St., London, Ontario.

D. H. Browne will go to Kingston, Ont., to have conferred by the Senate of Queens University of Canada, the honorary degree of LL.D. at its approaching convocation, Apr. 26.

J. H. Stovel has resigned the superintendency of the Mond Nickel Co.'s plant at Bruce Mines, Ont., and has been appointed an assistant inspector of mines, for Ontario, with headquarters at Sudbury.

A party of the Associated Geological Engineers from New York, consisting of Myron L. Fuller, Frank A. Herald and Ralph W. Richards, is conducting geological investigations in northern Oklahoma and southern Kansas.

At the annual meeting of the Taylor-Wharton Iron and Steel Co. for organization, the following were elected: Knox Taylor, president; Dr. Henry W. Howe, V. Angerer, P. Chrystie, vice-presidents; W. A. Ingram, secretary and treasurer.

Frederick G. Clapp, managing geologist of the Petroleum Division of the Associated Geological Engineers, has removed his headquarters from Pittsburgh to New York. The Pittsburgh office will be retained under the same management.

F. W. Horton, of the U. S. Bureau of Mines, has resigned to accept a commission with the Sterling Steel Co. He will have charge of securing a supply of tungsten and other alloy metals, and will probably have headquarters in Los Angeles, Calif.

Robert M. Knox, recently in charge of the stripping operations of A. Guthrie & Co., at Calumet, Minn., on the Mesabi Range, has gone to Chicago to take charge of the work on the Sag Drainage Canal. Charles Taylor is now in charge at Calumet.

Robert Sterling, who for the past two years has been chief engineer for the Goldfield Consolidated Mines Co., of Goldfield, Nev., is, from Apr. 1, with the Primos Chemical Co. as assistant manager at that company's vanadium mines at Vanadium, San Miguel County, Colo.

Walter Harvey Weed has connected himself with John E. Allen & Co., of Boston, as executive and has taken charge as managing director of the development of the Crystal copper mines in the Cataract mining district, Jefferson County, Mont., near Basin, on the Great Northern Ry. The properties are 30 mi. east of Butte.

Capt. William Bond, mining captain at the Newport mine, on the Gogebic Range in Michigan, for a long term of years, has been retired on a pension by the Newport Mining Co. He is close to 70 years of age and has been engaged in mining work since starting in the mines of Cornwall, England, when a boy. He worked faithfully for his employers in Michigan and has earned a rest.

Warren Wood, head of the Wood Drill Works, Paterson, N. J., celebrated his 25th anniversary in business by a dinner at the works on Apr. 1. Besides the employees of the works, a number of invited guests were present. Several speeches of congratulation were made and Mr. Wood was presented with a large floral horseshoe in commemoration of the anniversary. The affair was a great success and was much enjoyed by those present.

Frank A. Ross, of Spokane, Wash., was honored at the recent inauguration of Dr. Ernest O. Holland as president of the State College of Washington, by having conferred upon him the degree of Master of Science in Engineering "in recognition of his service to the mining industry of the great West." It is notable that only one other degree was granted and that this is the first honorary degree conferred by the State College upon an engineer.

Frederick E. Burbidge, of Spokane, has been made general manager of the Federal Mining and Smelting Co., succeeding to the vacancy caused by the resignation recently of Harry L. Day, president and general manager since June, 1912. Percy E. Smith, who served as assistant general manager under Mr Day, will continue in that capacity. Mr. Burbidge has been at various times manager of the Frisco mine at Gem, manager of the Bunker Hill & Sullivan Mining Co. and assistant general manager of the Federal.

OBITUARY

Harry Clary Jones, professor of physical chemistry at Johns Hopkins University and one of the highest authorities on the subject, died suddenly at his home in Maryland on Apr. 8. Professor Jones was born in New London, Md., Nov. 11, 1865, and was graduated from Johns Hopkins in 1889. Later he studied at the University of Leipzig and at Amsterdam and Stockholm. In 1895 he became an instructor in physical chemistry at Johns Hopkins. Since 1904 he had been a professor. He was an associate editor of the "Journal de Chemie Physique," the "Journal of Franklin Institute," and "Zeitschrift für Physikalische Chemie." Professor Jones was a member of the American Physical Society, the American Philosophical Society, the American Chemical Society, and the Washington Academy of Sciences. He was Langstreth medallist of Franklin Institute in 1913. Professor Jones is well known to readers of the "Journal" as the contributor of a noteworthy series of articles on his specialty a few years ago. Besides being one of the greatest authorities on his subject he possessed a remarkable gift of explaining it in language intelligible to the average man.

SOCIETIES

Missouri Mining Association — This association at the School of Mines, Rolla, Mo., held its regular monthly meeting at which an address was given by Philip N. Moore, first vice-president of the American Institute of Mining Engineers. Following this, an enjoyable smoker was held. The officers of the Association are: L. W. Ehlers, president; J. G. Reilly, vice-president; W. A. Shaw, secretary; H. A. Kluge, treasurer.

Royal Cornwall Polytechnic Society—This institution has made formal application for a treasury grant to complete and correlate the researches and experiments already made on the methods of production and extraction of tin and tungsten, on condition that a local contribution of £1,000 be raised and that the Institution of Mining and Metallurgy contribute £500. The Polytechnic Society has already given £100 toward the sum required.

Chicago Joint Committee on Military Engineering—A group of prominent engineers and contractors of Chicago and vicinity have coöperated in forming a Joint Committee on Military Engineering. The founders are members of all of the leading engineering and contracting organizations of Chicago, including the local branches of the national engineering societies. The purposes of the committee are to further military preparedness among engineers, contractors and their associates by courses of lectures; studies and practical instruction in military engineering; assisting engineers to qualify as officers in the National Reserve Corps of Civilian Engineers; urging enlistment in and support for engineer troops of the National Guard and such other organizations as the Government may create; furthering instruction in military engineering in training camps and the attendance in them of those qualified. The Joint Committee has already prepared a program covering the vital points outlined for a period extending from Apr. 20 to July 25. Something of interest will be taken up each week, including lectures by Lieut.-Col. W. B. Judson, Engineer Corps, U. S. A.; two lectures by Maj. P. S. Bond, Engineer Corps, U. S. A.; Lieut.-Col. Mason M. Patrick, Engineer Corps, U. S. A., and several exhibition drills, terrain exercises and inspection trips under the direction and guidance of various officers of the engineer troops of the Illinois National Guard. Additions to the program will be made from time to time. Engineers, contractors and their associates in Chicago and vicinity are invited to join the committee. Correspondence should be addressed to the secretary, Robert F. Hall, 111 W. Washington St., Chicago.

INDUSTRIAL NEWS

D. O. Marks will open an office and demonstrating plant at 712 No. Main St., Los Angeles, Calif., for his new pulverizer, which he is installing in industrial and gold-milling plants.

The New York Engineering Co., 2 Rector St., New York, has recently shipped to Colombia, for the use of a native company, two Empire hydraulic elevators, one 8-in. and one 12-in. These elevators are made of steel plate and have manganese-steel linings. Two No. 2 Empire giants were also sent to the same company, with other incidental equipment.

A heavy demand for the building of Heroult electric steel furnaces is leading to the extension of the machine-shop facilities of the Pencoyd plant of the American Bridge Co., Philadelphia, where complete units of this type of steel-making equipment now are being manufactured.

The C. F. Burgess Laboratories, chemical engineers, of Madison, Wis., has increased its capitalization to $100,000. The officers are C. F. Burgess, president; Vrooman Mason, vice-president; W. B. Schulte, secretary and treasurer. The Chicago office is in the Harris Trust Building, Duncan Keith, manager.

B. M. Mitchell, president of the Conveying Weigher Co., New York, has just returned from Salt Lake City, where he received separate orders from a large company for four plants. The conveyors in these will be from 28 to 40 in. wide, the total length between centers over 3,500 ft., requiring 7,000 ft. of conveyor belting. In all of the plants the company's five-pulley ball-bearing type of idlers and laminated rubber conveyor belts has been adopted as the standard.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of The Engineering and Mining Journal, published weekly at New York, N. Y., for Apirl 1, 1916.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Chester W. Dibble, who, having been duly sworn according to law, deposes and says that he is the Vice-President of Hill Publishing Co., publisher of The Engineering and Mining Journal, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Hill Publishing Company, 10th Ave. at 36th St., New York, N. Y.

Editor, Walter Renton Ingalls, 10th Ave. at 36th St., New York, N. Y.

Managing Editor, Percy E. Barbour, 10th Ave. at 36th St., New York, N. Y.

Business Manager, Lee E. Ives, 10th Ave. at 36th St., New York, N. Y.

2. That the owners are:

Hill Publishing Company, 10th Ave. at 36th St., New York, N. Y.
Owners of 1% or more of Stock Issued.
Estate of John A. Hill, 10th Ave. at 36th St., New York.
Arthur J. Baldwin, 10th Ave. at 36th St., New York.
Fred R. Low, 10th Ave. at 36th St., New York, N. Y.
John McGhie, 10th Ave. at 36th St., New York, N. Y.
Fred S. Weatherby, 1600 Beacon St., Brookline, Mass.
Frederick A. Halsey, 356 W. 120th St., New York, N. Y.
G. Eugene Sly, 50 Union Sq., New York, N. Y.
Frederick W. Gross, 215 E. 11th St., Erie, Pa.
Alfred E. Kornfeld. 10th Ave. at 36th St., New York, N. Y.
Emma B. Hill, 80 Munn Ave., East Orange, N. J.

The balance of the stock issued (less than 1% each) is owned by 68 employees, 3 ex-employees, and 13 others who are wives, daughters or relatives of employees.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages or other securities are: Mortgage on building, Dime Savings Bank, Brooklyn, N. Y.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by him.

CHESTER W. DIBBLE.
Vice-President Hill Publishing Co.

Sworn to and subscribed before me this 31st day of March, 1916.

[Seal.] RICHARD L. MURPHY.
(My commission expires March 30, 1917.)

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALUMINUM—Process of Producing Soluble Salts of Aluminum. Melville F. Coolbaugh, Rapid City, and Elwyn H. Quinney, Pierre, S. D. (U. S. No. 1,178,384; Apr. 4, 1916.)

CEMENT—Furnace or Kiln for Burning Cement, Lime and the Like. Klas H. Johansson, Säfsjö, Sweden. (U. S. No. 1,177,865; Apr. 4, 1916.)

COKE—Process of Treating Coal. Charles Howard Smith, Short Hills, N. J. (U. S. No. 1,177,727; Apr. 4, 1916.)

COPPER—Method of Forming Upon Copper and Copper Alloys a Layer Protective Against the Corrosive Action of Sea Water. Gustav Kurth, Bautzen, Germany, assignor to Firm C. G. Tietzen's Eidam, Bautzen, Germany. (U. S. No. 1,176,571; Mar. 21, 1916.)

CRUSHING—Ball-Grinding Mill. George M. Newcomer, New York, N. Y., assignor to F. L. Smidth & Co., New York, N. Y. (U. S. No. 1,177,648; Apr. 4, 1916.)

CRUSHING—Improvements in Crushing, Grinding and Pulverizing Machines. W. H. Soward, Kelston, Somerset, England. (Brit. No. 556 of 1915.)

CRUSHING—Screening Tube Mill. John Herman, Los Angeles, Calif. (U. S. No. 1,176,896; Mar. 28, 1916.)

CYANIDING—Process of Cyaniding. Harai R. Layng, San Francisco, Calif. (U. S. No. 1,178,081; Apr. 4, 1916.)

DRILL—Combined Rock Drill and Reamer Bit. Eugene L. Davidson, Burlingame, Calif. (U. S. No. 1,176,884; Mar. 28, 1916.)

DRILL—Miner's Drill. Charles F. Lindenmuth and Raymond A. Hanley, Aristes, Penn. (U. S. No. 1,178,402; Apr. 4, 1916.)

DRILL—Rock Drill. Omar E. Clark, Denver, Colo., assignor to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,177,683; Apr. 4, 1916.)

DRILLS—Lubricator for Rock Drills. William H. Leonard and Omar E. Clark, Denver, Colo., assignors to the Denver Rock Drill Manufacturing Co., Denver, Colo. (U. S. No. 1,177,-713; Apr. 4, 1916.)

ELECTRIC FURNACE. John W. Brown, Lakewood, Ohio, assignor to National Carbon Co., Cleveland, Ohio. (U. S. No. 1,177,680; Apr. 4, 1916.)

EXCAVATING—Conveyor Device for Excavating and Loading Machines . George W. Jackson, Chicago, Ill., assignor, by mesne assignments, to Bucyrus Co., South Milwaukee, Wis. (U. S. No. 1,178,449; Apr. 4, 1916.)

FLOTATION—Improvements in or Relating to the Concentration of Ores. E. H. Nutter, San Francisco, Calif. (Brit No. 19,856 of 1914.)

FUEL—Burning Pulverized Fuel. Henry R. Barnhurst, deceased, Catasauqua, Penn., by Henry G. Barnhurst, administrator, Catasauqua, Penn. (U. S. No. 1,178,464; Apr. 4, 1916.)

FUEL—Feeding and Burning Fine Fuel. Walter D. Wood, New York, N. Y. (U. S. No. 1,178,436; Apr. 4, 1916.)

FURNACE-CHARGING MECHANISM. Alfred C. Nelson, Lakewood, Ohio. (U. S. No. 1,177,720; Apr. 4, 1916.)

GOLD-SAVING DEVICE. George Edick and John E. Davern, Albuquerque, N. Mex. (U. S. No. 1,178,001; Apr. 4, 1916.)

OPENHEARTH FURNACES—Improvements in and Relating to Slag-Removing and Indicating Mechanism for Openhearth Furnaces. W. A. Kosinki and P. P. Rhodem, Chicago, Ill. (Brit. No. 1,193 of 1915.)

SEPARATION—Process of Electrical Separation. Henry Azor Wentworth, Lynn., Mass., assignor to Huff Electrostatic Separator Co.. Boston, Mass. (U. S. No. 1,178,430; Apr. 4, 1916.)

SEPARATOR—Magnetic Separator. Parvin Wright, Vancouver, B. C. (U. S. No. 1,177,981; Apr. 4, 1916.)

SETTLING TANK. Harry R. Conklin, Joplin, Mo. (U. S. No. 1,175,126; Mar. 14, 1916.)

SIGNALING—Apparatus for the Electric Transmission of Signs or Speech in Mines. Josef Heinrich Reineke, Bochum, Germany, assignor to Studiengesellschaft für drahtlose Grubentelefonie M. B. H., Cologne-Lindenthal, Germany. (U. S. No. 1,175,082; Mar. 14, 1916.)

SLIMES—Improvements in or Relating to the Treatment of Slimes or the Like in Rotary Drum Separators. W. Feldenheimer, London, Eng. (Brit. No. 24,179 of 1914.)

SMOKE—Protecting Thimble for Fume Bags. Cornelius F. Dougherty, Kennett, Calif. (U. S. No. 1,178,385; Apr. 4, 1916.)

STEEL—Method of Treating Steel. Christer Peter Sandberg, London, England. (U. S. No. 1,178,352; Apr. 4, 1916.)

TIN—Procession for Facilitating the Extraction of Tin from Cassiterite and Oxidation Products of Tin. G. Michaud and E. Delasson, Montreuli-a-Bois, Seine, France. (Brit. No. 614 of 1915.)

TOOL STEEL—Machine for Testing Tool Steel. Edward G. Herbert and Charles Fletcher, Manchester, England. (U. S. No. 1,176,291; Mar. 21, 1916.)

TUNGSTEN—Process of Producing Tungsten. Carl Bosch and Alwin Mittasch, Ludwigshafen-on-the-Rhine, Germany, assignors to Badische Anilin & Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. (U. S. No. 1,175,693; Mar. 14, 1916.)

WHITE-LEAD PIGMENT—Process for Separating Thallium and Radioactive Metals from Lead Ores and Producing a White-Lead Pigment. James Ballantyne Hannay, Hamburg, Germany, assignor to Deutsche Felsen-Oel-Gesellschaft Franzen u. Co., Berlin, Germany. (U. S. No. 1,175,146; Mar. 14, 1916.)

Editorial Correspondence

SAN FRANCISCO—Apr. 6

Voluntary Increase in Wages of Miners along the Mother Lode in Amador County took effect on Apr. 1. The increase, though only 25c. per day, was accepted by the miners with a sense of appreciation of the desire of the operators to deal fairly by them, in spite of the fact that the general advancement in mining and increased prices for metals and minerals brought about by the war demands, has no beneficial effect upon the gold mining industry.

The Reopening of the Old Eureka, sometimes known known as the Hetty Green mine, but which is now the Consolidated Amador, attracts attention of miners and mining investors to the fact that the large amount of gold produced by this mine, prior to 30 years ago, came from no greater depth than 2,000 ft. vertically. The Kennedy and the Argonaut mines are approximately of 4,000 ft. vertical depth. The essential fact is that these mines are, and have been for a number of years, great producers below the 2,000-ft. point. The same may be said of the South Eureka and the Central Eureka. This section of the Mother Lode, extending from the Argonaut on the south to the Old Eureka on the north, embraces the deepest mines and largest producers of the Mother Lode in Amador County. Just north of, and adjoining the Old Eureka, the Keystone is another of the old producing mines reopened two or three years ago and again on the producing list. The history of the mines here mentioned as neighbors of the Old Eureka, both past and present, was the fact upon which T. Walter Beam based his belief that the Old Eureka mine is a property worth reopening. After a careful study of the geology, development and operation of these properties, and after three years of almost continuous effort to induce Mrs. Hetty Green to part with the property, Mr. Beam has succeeded in making an outright purchase on behalf of men who are stockholders in United States Steel Corporation. Mr. Beam explained to the "Journal" correspondent what is not generally known regarding Mrs. Green's unwillingness to part with the property. The general belief that Mrs. Green was merely holding on for a large price was an error. The fact is that in the first place, and after the death of her husband, when she was the only member of the owning corporation who kept up the assessments and taxes, she desired to keep the property for the benefit and use of her son Colonel Green. But he had no more inclination than had his mother to engage in mining. Her well-known reluctance to sell the property was founded upon the fear that stock jobbers would get hold of it and, as she expressed it, flim-flam the public. Finally when Mr. Beam presented the list of names of men who would and did subscribe to the purchase of the property, Mrs. Green remarked, that she was "not afraid of that crowd" and that they could have it for a certain fixed price for an outright purchase and that they could take it or leave it alone. The price is generally known to be approximately $500,000. This is briefly the story of how the Old Eureka mine came into possession of the present owners and why no one was able previously to purchase. It will surprise a great many mining people in the West to know that Hetty Green actually held on to the mine because she was afraid that it might be used for swindling the public. But this is the fact. The work of installing pumping machinery for unwatering the mine is progressing as rapidly as the movement of freights will permit.

DENVER—Apr. 7

The Empire Zinc Co. Has Purchased a considerable area of well-known property in Stray Horse Gulch, Leadville, including the Robert Emmet, Forest City, Result, Gonabroad and Ranchero claims, each of which has a record of large production. This group has been owned for years by the Small Hopes-Boreel Mining Co. and is reported as producing at present ore averaging about $30 per ton in the various metals.

The Colorado Metal Mining Association has been called upon to give consideration to the Foster bill (H. B. 12,275). President Bulkley Wells has appointed a special committee to send out circular reports on the bill to the various county subsidiary organizations. Copies of the bill have been mailed to mining men throughout the state and upon hearing the opinions of these men, the Association will hold a meeting to prepare resolutions and recommendations to Washington.

Tungsten Continues to Maintain the Intense Interest of a large portion of Colorado's mining men. Despite gloomy prophecies advanced by various persons in regard to the limited future for the metal, prospecting continues without abatement. Mills are being erected as rapidly as materials can be delivered. Silverton is excited about the recent disclosure of hübnerite close to town in Sultan Mountain where it has been identified in old workings of the Little Dora. Jack G. Clark, of the Boulder Tungsten Production Co. says he has 25 tons of high-grade concentrate almost ready for shipment. A new company styled the Rare Metals Ore Co., backed by Guilford S. Wood, Irving T. Snyder, Adolph J. Zang and associates—all successful mining men and prominent in the affairs of the Vindicator Consolidated Co.—is erecting a custom concentration mill of 75-tons' capacity at Rollinsville in northern Gilpin County. The plant will have a complete sampling department and due to its situation on the main line of the Moffat Road will be enabled to receive shipments from any part of the United States. The flowsheet embodies, beside the sampling machinery, rolls, impact screens, jig, spitzkasten, Wilfley tables, Akins classifier, 4x3-ft. ball mill, more Wilfleys and a Deister table. The plant was designed and is being erected by the Colorado Iron Works. It will be managed by Nelson Franklin who has managed the Eagle sampler at Victor for the last 16 years.

BUTTE—Apr. 6

A Powder Plant Is to Be Built on a 1,200-acre tract, just above Dawson, a station on the Northern Pacific, the Milwaukee, and the B. A. & P. railways, 10 mi. west of Butte. The Du Pont powder company will at once begin the construction of a large plant for the manufacture of dynamite, gelatin and other explosives. The plant will cost about $500,000, and when completed will employ between 100 and 200 men. Its capacity will be sufficient to supply all the needs of the mining industry in the Northwest. A broad-gage track will be run from the B. A. & P. tracks to the plant and connection made with all its departments. Completion and operation is expected by the end of the year. One of the reasons for locating the plant near Butte is that the high cost of transporting the finished explosives makes the location in a mining center desirable. It is estimated that Butte alone uses about 6,000,000 lb. of dynamite per year. The nearest powder manufactory at present is that at Du Pont, Wash. The plant will include a small nitric acid and possibly a small sulphuric acid department. While the freight rate on these materials is not excessive, it is on the finished product. A manufactory near its chief market will, therefore, have a great advantage.

The Butte & Bacorn Company's Reorganization Plans are as follows: A new company is to be formed under the name of Great Butte Copper Co. as soon as funds required are in sight. The new company is to have 1,000,000 shares of stock of par value of $1. Two hundred thousand shares are to remain in the treasury. The plan is to sell all of the property of the Butte & Bacorn to the new company for 400,000 shares. This will give each stockholder one share for every 10 he now holds. This plan amounts to the same thing as if all stockholders were to give up one-half of their stock to be sold for the benefit of the enterprise. The new stock will be sold at 66c. per share, and funds thus realized will amount to $264,000. Out of this must be paid debts of the old company with interest, costs of reorganization, etc., amounting to $65,000. The new company will buy for $19,000 the 1,000-ft. Calumet shaft which is sunk just outside of the company's lines but on ground held under option. After paying the indebtedness and getting back the Calumet shaft, the new company will have about $180,000 available for continuing development work. Most of the work will be done on the 1,500-ft. level but if necessary, sinking may be done. The property is located 1 mi. north of Butte & Superior. The indications are that it contains valuable bodies of both copper and zinc ores.

SALT LAKE CITY—Apr. 7

At the New Zinc Camp on Promontory Point, 25 mi. west of Ogden, activity continues to increase. About 12 properties are being worked. A shortage of good water in the district is being made good by a supply received from the Ogden city waterworks. The Lakeview company, which during the past year

has made a record of steady production and dividend payments, is receiving 21,000 gal. a week, and other companies will probably make similar arrangements. The water is brought in tank cars of 7,000 gal. capacity to Saline on Promontory Point, and from there it is hauled to the Lakeview.

The State Conservation Commission at its monthly meeting held recently decided to make an investigation of the potash deposits of Utah and the possibilities for the further development of the potash industry. T. L. Allen, field secretary, has been instructed to take up this work and report to the commission. There have been many inquiries about potash since the war began, and the state desires to have on hand complete and accurate information. The commission has also decided to make qualitative tests of minerals and ores for the benefit of those who want information regarding them. Samples will be tested at the University of Utah School of Mines. No quantative analyses or assays will be undertaken. Information regarding the mineral resources of the state will be kept on file in the office of the commission, at the capital. The commission consists of Governor William Spry, O. J. Salisbury, H. T. Haines, J. E. Pettit and T. L. Allen.

The Utah Chapter of the American Mining Congress is obtaining signatures to a petition urging that the United States Geological Survey prepare and publish a Professional Paper on the Cottonwood-American Fork region. This section is now attracting much attention from operators and investors. The survey has thus far given only a reconnaissance on the Cottonwoods and American Fork which is not sufficient for the direction of mining operations. Signatures to the petition as well as personal letters to Utah's congressional delegation are desired in order to get prompt action and have the work started this season. Data on the district embodied in the petition was obtained by the Utah chapter from the best sources. The petition is addressed to Senators Reed Smoot and George Sutherland, and to Representatives Joseph Howell and J. H. Mays. It states that the signers actively interested in mining in Utah respectfully urge that the United States Geological Survey give first preference to the Big Cottonwood, Little Cottonwood, and American Fork mining districts, as the subjects for the next professional paper written about Utah by the Survey.

JOPLIN, MO.—Apr. 8

James F. Gallagher's Plan of contracting for at least 3,000 tons of this district's zinc ores and guaranteeing the producers an 8 to 1 ratio of payment for it was presented by him to the mine operator members of the Southwest Missouri Mine Safety and Sanitation Association, at its regular weekly meeting at Webb City, Thursday. This is the strongest mine operators' association this district has ever known. Mr. Gallagher was asked a number of pertinent questions about his plan. One producer wanted to know how he was going to determine the "1" in the "8 to 1" ratio. Mr. Gallagher said that would have to be determined, as it always had been, by supply and demand. Another producer asked if he would have money enough back of him to finance the holding of 3,000 tons of zinc ore for any length of time. Mr. Gallagher declared he had money enough back of him to finance his proposition. A committee of five was authorized by the association to confer further with Mr. Gallagher and thoroughly investigate his proposition. The general sentiment of the operators seems to be that of doubt as to whether the scheme is feasible.

ST. LOUIS, MO.—Apr. 10

Under the Stimulus of Sc. Lead, the highest price in over 40 years, the disseminated lead belt of southeastern Missouri is unusually active and conditions are highly prosperous. The wage scale has been increased by a bonus of 20% throughout the district on all classes of labor. Diamond drilling is more active than for many years and several new discoveries are reported.

TUCSON, ARIZ.—Apr. 5

The Profit in the Tungsten Mining Industry has just had public demonstration locally in the arrest of a number of Mexican miners for highgrading. They were in the employ of the International Tungsten Co., in Las Guijas district, southwest of Tucson. Their quarters were searched by a zealous peace officer, who had come to take up all firearms held in the possession of Mexicans who might become a menace to the peace of the border. In their tents were found many small sacks of rich ore, brought from the shallow workings in the pockets and the lunch pails of the miners. Manager Hiram Whitcomb's trail of investigation led to Tucson, where a five-ton lot of tungsten ore, valued at $5,000, was seized at a testing plant in the suburbs, having been identified by the uniform peculiarity of the crystallization of wolframite from Las Guijas.

The Custom Smelters Have Raised Their Rates, actuated evidently by the intention of sharing in the profits of the high priced metal times and by a desire to handle only the higher grades of ore giving the maximum bullion production. Smelters now have a base rate charge of $5 a ton for reduction, this being double the former figure. In addition there is a minimum deduction of 20 lb. of copper for all ore assaying less than 10% and there is a higher ratio of deduction for moisture. Getting down to concrete figures, it is now made evident that shippers from this section can make no money on 6% ore, even with copper quoted at 26c. The dumps will have to be sorted over for at least 10% ore, which means that hardly a third of the possible shipments may be sent out in future. Hence owners of low-grade Arizona copper mines are apparently not to profit materially by high prices unless they happen to own their own reduction works.

HOUGHTON, MICH.—Apr. 5

March Production of Copper from the Lake Superior mines was approximately 24,000,000 lb.

Practically Every Michigan Shareholder of Tamarack is turning in his stock for $59 on the Calumet & Hecla offer. The average Tamarack shareholder knows that his Tamarack stock is worth little when copper is selling at 14c. He knows that from the cost figures during the years before it was managed by the Calumet & Hecla interests, when the pounds per ton were higher and hoist shorter. On the present high price of copper he feels that the price is too low. At the same time he figures that it may be a long time before he can ever get $59 for his stock any other way.

ISHPEMING, MICH.—Apr. 10

It Will Be at Least Two Weeks before it will be possible for boats to load ore for lower lake ports, according to reports received from the ports on Lake Superior and the Soo. It was thought for a time that an effort would be made to force a passage to the docks at Escanaba, in order that ore could be shipped there from the Gogebic Range for furnaces at the southern end of Lake Michigan, but the project had to be abandoned when it was found that the ice was too thick to be broken with ice crushers. This was a disappointment to the Steel Corporation, which was reported planning to ship about 500,000 tons from Escanaba before boats could pass through the Soo. Some of the mining companies have been complaining that they will not be able to ship all of the ore sold as they are unable to charter boats. The Steel Corporation, which has a large fleet, entered the market early and tied up a lot of boats with contracts for this year, and so is well supplied.

RUSH, ARK.—Apr. 6

Since the Price of Zinc Ore went to unprecedented figures, the little camp of Rush, Ark., has been growing rapidly. Two years ago there was little more to this camp than the Morning Star mine, one of the veterans of the North Arkansas district. Now there are half a dozen concentrating plants in active operation within 2 mi., and any number of small companies burrowing in the hillsides. Two years ago the population was less than 100; now it is estimated at 2,000. The Yellville, Rush & Mineral Belt Railway Co. is engaged in building a narrow gage railway connecting the camp with the White River line at Yellville. Good progress is being made and it is expected the road will be ready to receive freight shipments by July 1. In 1915 the total output of ore from the Arkansas field was 15,428,010 lb. of which the greater part came from the Rush section. The biggest single producer was the Philadelphia, which had over 1,000 tons of high-grade silicate to its credit. The Sure Pop, the Red Cloud and the Morning Star were only a little behind.

TORONTO, CANADA—Apr. 8

The Question of Government Control of the output of the Sudbury nickel mines came up Apr. 3 in the Ontario Legislature. Samuel Carter, M. P. P. for South Wellington, moved a resolution "that in the opinion of this House, the production and sale of nickel in this Province should be under government control, and that negotiations should be at once entered into by the Government of this province with the government of the Dominion of Canada, and the Government of the United Kingdom, to secure united action to acquire the absolute control of the nickel mines and nickel product of the Province of Ontario." This resolution was keenly debated for several hours and strongly supported by the Liberal members of the House. It was opposed by the Government on the ground that the time was inopportune, pending the report of the Ontario Nickel Commission, and was finally declared lost on division. The resolution was evidently introduced rather with the object of putting the Liberal party on record and furnishing campaign material for future elections, than with any expectation of its being adopted, and furnishes another of many recent indications that the policy outlined will be made a leading hot-air party issue.

The Mining News

ALASKA

KENNECOTT COPPER (Kennecott) — March production was 10,150,000 lb. copper compared with 9,750,000 lb. February and 10,000,000 lb. for January. Production to date approximately 93,000,000 lb.

ALASKA GOLD (Juneau)—During March treated 162,796 tons ore of gross value $1.03 per ton as against approximately 123,000 tons in February, of same grade. This is largest tonnage treated per month by company.

ARIZONA

Cochise County

SHATTUCK-ARIZONA (Bisbee) — Production for March was: 1,594,330 lb. copper; 714,379 lb. lead; 32,187 oz. silver; 394 oz. gold. Company announces removal of its general offices from Duluth, Minn., to 120 Broadway, New York City.

Gila County

MIAMI (Miami)—March production was 4,192,000 lb. compared with 3,990,936 for February.

OLD DOMINION (Globe)—March production 3,277,000 lb., compared with 2,823,000 in February.

CASTLE DOME (Globe)—Company recently organized to take over Castle Dome and Inspiration Extension claims has installed machinery on Castle Dome and will drive tunnel started by old company at rate of 300 ft. per month. Tunnel has opened ore averaging 1½% copper.

AMERICAN SMELTING AND REFINING (Hayden)—Fire destroyed wooden sample mill and about one-third of ore bins Apr. 11. New steel sample mill and additional bins under construction were not damaged; these will be ready in about two months, during which smelting plant will be embarrassed in handling ores requiring crushing, but will probably be able to handle about normal amount concentrates.

Mohave County

ARGO (Oatman)—Vein struck at 360-ft. level.

OATMAN APEX (Oatman)—Will buy hoisting plant, compressor, and machine drills.

KINGMAN ZINC (Kingman)—Shipping weekly 30 tons concentrates, valued at $15,000, to Bartlesville, Okla., smelters.

LUCKY SAM (Oatman)—Shaft down 110 ft. and vein on which it was sunk now widened out to 2 ft. assaying $15 per ton.

UNITED WESTERN (Oatman)—Main vein cut at point 285 ft. in from shaft by southwest cross-cut of 500-ft. level; 5 ft. good mill ore exposed.

TELLURIDE CHIEF (Kingman)—A 9-ft. vein assaying $5 gold and silver and 10% copper found at depth of 5 ft. while grading site for hoist. Company will sink shaft 100 ft. and intersect vein with crosscut.

RED REEF (Oatman)—Chicago syndicate will begin extensive development work. Men behind syndicate are J. J. Mitchell, president of the Illinois Trust Co.; Edward Swift, president of the Swift Packing Co.; Wm. W. Rigley, owner of spearmint-gum company, and David Blankenborn and R. E. Hunter, of Pasadena, Calif.

Pima County

NEW CORNELIA (Ajo)—Railroad completed to Cornelia. Concrete work started on the mill foundations.

COPPER CHIEF (Tucson)—Pillsbury Engineering Co. of Pittsburgh awarded $200,000 diamond-drilling contract on company's claims in Quijota Mountains.

INTERNATIONAL TUNGSTEN (Tucson)—New corporation, capitalized at $10,000,000, organized to develop tungsten properties in Las Guijas district. Organization absorbs National Tungsten Co. and Emory-Whitcomb properties. The Las Guijas tungsten mines present daily output valued at $2,500; 10 new stamps being added to old 10-stamp mill and 30 more may be installed. President of new corporation is H. Whitcomb. About 300 men empolyed in district.

Pinal County

RAY HERCULES (Ray)—Twelve drill holes recently completed have considerably widened known mineralized area. Holes north and east of first drilled section proved 90 to 145 ft. ore averaging over 2% copper.

Yavapai County

ALTO GROUP (Prieta)—D. C. MacIver will erect mill.

CONSOLIDATED ARIZONA (Humboldt) — Production for March was 365 tons copper bullion compared with 250 for February.

FAIRVIEW (Crown King)—A 26-in. streak of sulphide ore struck in 240-ft. tunnel, at 100 ft. vertical depth; samples assay $35 a ton, chiefly in gold.

CONGRESS GOLD (Congress)—Merrill Metallurgical Co., of San Francisco, which recently took over the property, has decided not to treat big dump until price of cyanide goes down.

TUNGSTEN (Castle Hot Springs)—Plant to treat custom ore from the Tule Creek district will be erected by N. H. Gethell, associated with John Lindell and Robert Griffith, of Prescott.

BLUE RIBBON (Prescott)—An 18-in. streak of chalcopyrite ore running 16% copper and $18 gold a ton struck at 20-ft. depth. Mrs. Mollie Potts, of Prescott, owner; J. C. Show is in charge.

PROMOTER (Prescott)—C. E. Warren and B. F. Peters have developed 4,000 to 6,000 tons oxidized ore and will erect mill. Installation of stamp mill with flotation section made probable by results of test runs.

RINCON (Congress)—Reported that New York capitalists are behind property recently taken over by W. B. Twitchell and Joseph Cope, of Phœnix, for Dixie mines company. The 1,200-ft. shaft entirely unwatered; force of miners being increased.

CALIFORNIA

Amador County

ARGONAUT (Jackson)—Installation of new underground hoist on 3,900 level completed and trial operations begun.

CONSOLIDATED AMADOR (Sutter Creek)—Foundation for headframe and necessary machinery for unwatering and reopening mine nearly completed and machinery arriving.

ORIGINAL AMADOR (Amador City)—Radical changes being made in mill whose equipment consists of 20 stamps, a Symons crusher, two Hardinge mills, and Deister tables. Former practice used stamps for crushing and Hardinge mills for regrinding. Experimental process begun Apr. 1, dispenses with stamps, taking ore from Blake breaker to Symons crusher and thence to one Hardinge mill. Probability of increased tonnage already demonstrated. During experiment slimes largely reduced and two of three slime tables eliminated.

Eldorado County

ROCKY BAR (Fairplay)—Property being equipped with modern placer machinery at cost of $7,000.

GEORGIA SLIDE (Georgetown)—Installation of equipment almost completed; mill expected to operate soon.

Kern County

KING SOLOMON (Randsburg)—Last cleanup from 190 tons ore crushed at Red Dog mill, yielded $4,600.

Napa County

BELLA UNION (Oakville)—Possession of quitclaim deed to this property is basis of suit in Superior Court, Alameda County, by Roscoe L. and Laura F. Jennings against the Federal Trust Co., of San Francisco. Deed was to have been delivered to Bella Union Quicksilver Co. upon performance of improvements and organization of $50,000 stock company. Plaintiffs alleged contract not carried out and asked that Trust Co. be restrained from delivering the deed.

Nevada County

ALLISON RANCH (Grass Valley)—Purchase option reported taken by Judge McLaughlin and S. Wicks, of Sacramento. Property formerly owned by James L. Flood and Clarence Mackay. Other properties in the vicinity are included in deal.

Placer County

LIVE OAK (Coalfax)—Mill has installed new Williams stamp and another one will be added. Ore milled, assays $15 per ton. Shaft down 175 ft. and will be deepened to 275 ft. Air compressor installed.

Shasta County

MAMMOTH (Kennett)—The 4,000-ft. tunnel started on Friday-Lowden group last December, now in 1,030 ft., work having advanced at rate of 10 ft. a day. Equipment added to enable drifting to increase to 15 ft. a day. Company will install aërial tramway from Stowell mine to connect with Balaklala line and enable shipment of ore from Stowell by way of Coram to Kennett smeltery.

Sierra County

SACRED MOUNT and BUTTE SADDLE (Sierra City)—Bonded to San Francisco operators; developments to begin at once. Phelan Brothers, owners.

GREY EAGLE (Downieville)—Both shafts and connecting drifts unwatered, and mine under examination by Sidney C. Love representing New York company.

MUGWUMP MINES (Alleghany and Forest) — William Hague, of Grass Valley was not among organizers of this company as stated in news item Mar. 4, and has no connection with company.

COLORADO

Boulder County

CONSOLIDATED LEASING (Eldora)—Has secured lease on property of the Swarthmore Mining and Milling Co. and plans campaign of active development.

LUCKY SEVEN LEASING (Boulder)—Company headed by Fred Fair has secured lease on Yellow Pine properties. Development will be undertaken soon.

NELSON (Ward)—Property to be reopened and developed by Boulder mining men, including W. W. Degge, R. R. Thomas, and F. E. Eckel. The 400-ft. shaft will be unwatered and development of lower workings extended.

COLBURN MILL (Boulder)—Plant in Boulder Cañon at mouth of Bummer Gulch purchased by W. W. Degge and J. G. Clark. Mill will be equipped with new machinery within 60 days and operated as custom plant to treat ores from Sugar Loaf, Bummer Gulch and Magnolia. New equipment will be furnished by the Colorado Iron Works.

Lake County

DERRY RANCH GOLD DREDGING (Leadville)—Dredge started operation recently after winter breakup.

San Juan County

DAWN OF DAY (Silverton)—Additional men employed in development of this tungsten property. Ore will be treated in Yukon mill. Louis Schafer is manager.

HERCULES (Silverton)—The 120-ft. shaft on Dora vein unwatered, making accessible about 1,300 ft. of drift on vein. Examination of drift disclosed fine streak of hübnerite ore. In breast of northwest heading vein is about 2 ft. wide, well mineralized. Similar ore found also in southeast heading exposed over distance of several hundred feet. Main streak high-grade hübnerite is 5 in. thick and vein mineralized in places over a width of 3½ ft. Hübnerite long known to exist in mine but not regarded as important till recently. Contract will be let at once to sink shaft another 100 ft. Company contemplates remodeling mill and installation of flotation equipment. Joseph Joyce is manager.

COLORADO

San Miguel County

MARCH SHIPMENTS of ore and concentrates made from Telluride as follows: The Smuggler-Union, 52 cars; Tomboy, 60; Liberty Bell, 15; total, 127 cars.

SANTA CRUZ (Ophir)—Property reopened by John Mayers and C. Wichman.

CARBONERO (Ophir)—Contract let to advance Shoofly tunnel an additional 500 ft. Geo. B. Pickett is manager.

TOMBOY (Telluride)—Company has secured lease on Favorite mine in Ophir district. Property will be developed and tests on ore made in old Suffolk mill.

MELDRUM UNITED TUNNELS (Telluride) — Controlling interest secured by M. R. Hansen, of Telluride, who bought it at a sale to satisfy judgment of $10,350.

WESTERN COLORADO POWER (Telluride)—Is installing three large General Electric transformers in connection with its power distribution system to mines in Savage Basin. New installation will cost about $15,000.

JURICH MINING AND LEASING (Ophir Loop)—Company has secured Butterfly mine and mill under lease. Property will be developed and mill placed in operation soon. Planned to treat custom ores from neighboring properties at company's 20-stamp mill.

SMUGGLER-UNION (Pandora)—The 30-ton testing plant installed to treat ores from Humboldt and Black Bear properties by flotation now in operation. If present tests are encouraging company will probably install larger plant. Mill recently destroyed by fire on Carruthers lease to be rebuilt by Perino and associates. New plant will contain two 30-ton ball mills. Lease runs for two years. A small force now employed in underground development.

IDAHO

Shoshone County

REINDEER-QUEEN (Mullan)—Considering plans to install hydro-electric power plant to not only drive its own equipment but also furnish power to neighboring Carney Copper and Carbonate Hill companies.

RAY-JEFFERSON (Wallace)—Two important strikes made recently in Beaver Creek district mine. Carlisle Tunnel No. 3, now driven in 800 ft., struck 10-ft. width ore, of which 3 ft. was of high-grade concentrating two into one, assaying 8% lead, 3 oz. silver and 33% zinc per ton, and additional 7-ft. width concentrating six into one. Mountain Goat-Ray No. 2 tunnel, now 2,000 ft. in, struck 12 ft. good mill ore. Materials for new 250-ton flotation plant now being delivered.

BUNKER HILL & SULLIVAN (Kellogg)—Ground will be broken soon for new smeltery to have initial capacity of 1,000 tons daily and provision made later for custom ores. Plant will be built on 120-acre tract comprised by Bingham and Giovetti ranches a short distance from the mine and concentrator plants. Equipment will include in sampling and roasting departments Dwight-Lloyd sintering machines and Wedge turret roasters. There will be three blast furnaces and a 200-ft. reinforced-concrete stack, bag houses and an electrolytic refinery to desilver the lead bullion. Several hundred men will be employed soon.

MICHIGAN

Copper

WHITE PINE EXTENSION (Ontonagon)—Drill cores continue to show good results. Shaft sinking progressing.

HANCOCK (Hancock)—Good rock being mined, stamping 18 lb. copper to ton; shipping 400 tons daily. No. 2 shaft sinking.

Iron

HOLMES (Ishpeming)—Shaft sunk 90 ft. in March; now concreted to ledge; when completed will be over 900 ft. deep.

ANVIL (Bessemer)—Thirty cars of ore shipped daily to Mayville, Wis., furnace. Very little ore left to place in stock.

ATHENS (Negaunee)—Shaft sunk 130 ft. in March; now down about 1,400 ft. Will be concreted from top to bottom.

DOBER (Iron River)—Open pit will be filled in attempt to rid mine of sulphur fumes that caused suspension of operations underground. Believed that by filling all openings from pit to mine that fumes trouble will be ended. Estimated that 800,000 yd. dirt will be required to fill pit.

FORTUNE LAKE (Crystal Falls)—Operations to be resumed and original plans carried out except that Briar Hill Creek will be turned from present course. Steel being laid on grade built last fall. Three drills still at work. While work was suspended last summer because drill samples did not give satisfactory results, sulphur content being too high, additional drillings have set aside all fears. Orebody is large. There will be two shafts.

MINNESOTA

Duluth

MINNESOTA STEEL (Duluth)—Plans erection of sufficient dwellings to house 200 additional families at Morgan Park Company hospital, a $75,000 structure, nearing completion.

DULUTH, MISSABE & NORTHERN (Duluth)—About 400 men will be employed at docks this season, practically all hired. Docks Nos. 3, 4 and 5 will handle ore, while No. 2 will handle crushed stone for the Duluth Crushed Stone Co.

Cuyuna Range

CUYUNA MILLE LACS (Ironton)—Officials deny statement that company has sold 50,000 tons. On contrary they state that American Manganese Mfg. Co., of which above is a subsidiary, is in market to purchase additional manganiferous iron ore.

ONAHMAN (Manganese)—Car of manganiferous material shipped to Zenith Furnace Co., Duluth, from Ferro mine, averaged 22.64% manganese and 27.72% iron. Company has sold entire production for Eastern consumption at such price that above would bring $5 per ton.

IRON MOUNTAIN (Manganese)—Organization named Hoch Mining Co. has taken lease on property, and mine will hereafter be called Hoch mine. Capitalization, $100,000; shares, $100 each. Officers are: President, Reiner Hoch, Duluth; vice-president, Carl Misske, Marquette, Mich.; treasurer, Walter Hoch; secretary, W. A. McClaran; general manager, Otto Wendlandt, Duluth.

Mesabi Range

WEBB (Hibbing)—About 200 men working. Washing plant expected completed by June 30, when additional 100 men will be required.

LAMBERTON (Hibbing)—Stripping operations progressing with one shovel and ore expected uncovered by July 1. An additional shovel will be started soon.

LARUE (Nashwauk)—M. A. Hanna Co. has added 3 ft. Wetherbee concentrator to concentrating plant, which will probably handle 300,000 tons in 1916.

MACE (Nashwauk)—Two new Marion shovels arrived for stripping. Large 315-ton shovel transferred to Quinn-Harrison. Increased crews will be employed and work rushed.

SILVER (Virginia)—Electric haulage, recently installed, now working. Electric compressor, 1,000 cu.ft. capacity, also installed. Ore being mined underground from sides of pit. Will last for two or three years, employing 160 men.

WEBB (Hibbing)—Shenango Furnace Co. constructing washing plant to concentrate ores from underground workings which will be only plant of its kind on Range. Plant will contain screen, one 25-ft. log washer and one 18-ft. log washer. Machinery expected in place by May 1. Mine producing about 25,000 tons a month.

MONTANA

Beaverhead County

BEAVER MINING (Dillon)—Articles of incorporation filed at Dillon; capital stock, $50,000. Directors are William Harmon and others of Butte. Company will open old copper properties at Browne's.

Lewis and Clark County

MARYSVILLE DISTRICT—A deal reported to involve $500,000 made for purchase of property including claims of Marysville Gold Mining Co. and Dorrity company, Lynch and Spokane groups on Mount Pleasant, Honeycomb, Blue Bird, Hickey and other claims of the St. Louis Mining and Milling Co. and two claims of Charles Maygear; total acreage purchased, about 500. Deal made by L. S. Ropes and Al. L. Hewitt. Properties are all gold producers and in past years have yielded thousands of dollars. New owners will put large force of men at work immediately.

Silver Bow County

DAVIS-DALY (Butte)—Directors have authorized installation of new hoist capable of raising ore from 3,500 feet.

BUTTE & GREAT FALLS (Butte)—To obtain additional funds for development of property recently acquired, directors will hold meeting at Great Falls on May 24 and vote on resolution to increase capital stock from 500,000 to 1,000,000 shares.

BUTTE & LONDON (Butte)—Shaft now down 1,446 ft. still in vein first encountered at 1,390 ft. Sinking will be continued to 1,600-ft. level where crosscutting north and south to end lines, will be started. Fifty men employed in three shifts.

EAST BUTTE (Butte)—New orebody reported opened on 1,500-ft. level of company's Pittsmont mine, 8 ft. wide and carrying between 6 and 7% copper. March production of company was approximately 1,320,000 lb. copper, as against 1,277,000 lb. in February.

BUTTE-BALLAKLAVA (Butte)—Management has made deal with Anaconda whereby latter will mine for former high-grade in Ballaklava ground, now being developed in drift from Anaconda's High Ore mine. High Ore drift being extended into Ballaklava at depth corresponding to 2,200 level of latter, or 600 ft. below present bottom of Ballaklava shaft.

PILOT-BUTTE (Butte)—Sale of Pilot-Butte property to Anaconda ratified at price of $1,125,000. With transfer completed, directors of Pilot-Butte will collect cash, adjust all liabilities and order distribution of treasury funds to stockholders, after which Pilot-Butte company will be dissolved. Sale was largely due to pending litigation which promised to be long drawn out.

BULLWHACKER (Butte)—West wall of glory-hole caved recently, bringing down ready for shipment about 5,000 tons ore. East Side Mining Co. operating on royalty basis from Bullwhacker company. Regular shipments made for some time to Tacoma smeltery, but now about to close contract with Garfield, Utah, smeltery. Shipments of 150 to 200 tons of ore made daily. Average recovery about 45 lb. copper per ton.

NEVADA

Esmeralda County

GOLDFIELD CONSOLIDATED (Goldfield)—Estimated production for March, 300,000 tons; gross extraction $210,000; operating expenses, $156,000; net realization, $54,000.

PIONEER CONSOLIDATED (Pioneer)—Annual report shows mine on profitable basis. Mill treating about 40 tons per day. Main office moved from Denver to Pioneer.

CHAMPS d'OR FRENCH GOLD MINING (Hornsilver)—Dunfee leases shipping at rate of three cars per week valued at $25 per ton. New shaft now down 350 ft. where drifts on ore have been started.

NEVADA METALS EXTRACTION (Goldfield)—Plant completed and running smoothly. Initial shipment, consisting of 50 tons of concentrates valued at $70 per ton shipped Apr. 6. Plant erected by leasing company to treat Florence dump ores. Has crushing capacity of 150 tons per day and a flotation treatment capacity of 300 tons per day. Janney flotation machines used.

Lincoln County

CONSOLIDATED NEVADA-UTAH (Pioche)—New 100-ton concentrating plant completed and practically all machinery in place. Tables will be followed by flotation. Expect to start running Apr. 15.

Nye County

TONOPAH ORE PRODUCTION for week ended Apr. 1 was 8,540 tons compared with 8,544 for week previous. Producers were: Tonopah Belmont, 3,096 tons; Tonopah Extension, 1,800; Tonopah Mining, 1,775; Jim Butler, 800; West End, 622; Rescue-Eula 86; Cash Boy, 62; North Star, 59; MacNamara, 50; miscellaneous leases, 192 tons.

WEST TONOPAH MINING (Tonopah)—Reported refinanced with about $50,000 available for immediate development.

BLACK MAMMOTH (Manhattan)—Property situated about 1 mi. below Manhattan, recently taken over under lease and bond by Record Lode Mining Co. Stated property contains large tonnage of low-grade ore. Development under direction of J. J. McCarthy.

Storey County

OPHIR (Virginia)—Necessary repairs to central tunnel completed.

MEXICAN (Virginia)—Prospecting drifts 2,500 and 2,700 levels in porphyry and quartz of low assay. Mexican mill received 454 tons custom ore averaging $18.90 and gross value about $8,000.

CON. VIRGINIA & OPHIR (Virginia)—Joint west crosscut on 2,700 level discontinued. Drifting north and south from 118-ft. point in crosscut on heavy quartz formation dipping east and of low assay.

SIERRA NEVADA (Virginia)—Saved from No. 1 stope 2,500 level, 92 tons of ore, averaging $15.04 per ton. West crosscut from bottom of winze in No. 1 stope advanced to 19-ft. point, face showing porphyry and quartz of low assay.

UNION CON. (Virginia)—Extracted 363 tons of ore valued at about $7,000, as follows: 120 tons, averaging $31.89 from No. 4 stope, 2,400 level; 151 tons, averaging $11.30 from No. 5 stope; 90 tons, averaging $16 from No. 1 stope, 2,500 level. Reopening north drift 2,700 level. Union shaft reopened to 2,300 level.

NEW MEXICO

Dona Ana County

PHELPS-DODGE (Organ)—Has begun work on recently acquired property in Organ district. Reported that 200 men will be employed soon. District court has settled status of the "jumped" Papoose claim, giving it to Torpedo company, thus bringing it under Phelps-Dodge lease.

Luna County

OLD HEARST (Gage)—Mines taken over by Chas. Qualey and John F. Fulkerson under lease and bond from L. R. Bradley. Extensive development has commenced.

GAGE TUNGSTEN (Gage)—Nevada Hills Mining Co., of which George Wingfield is principal stockholder, has bought Gage tungsten properties, 4 mi. south of Gage. The property consists of 8 claims, developed by two shafts, 90 and 130 ft. deep. A 20-ft. shoot of tungsten opened on 40-ft. level. New owners planning extensive development and installation of concentrator.

OREGON

Josephine County

COPPER QUEEN (Leland)—Heavy rains during winter have made road so bad that ore shipments to Tacoma are almost at standstill.

GOLD NOTE (Grave Creek)—Road as far as Eastman Creek being repaired and pack trail built remaining 8 mi. to mine. Ore will be shipped to Tacoma smeltery.

COLUMBIA (Placer)—A. C. Epperly, manager, anticipates a record season owing to the heavy snowfall. Some good nuggets have been picked up on bedrock recently.

JIM BLAINE (Placer)—Operated for past year by Borgman Bros. Development work during winter has opened ore to depth of 250 ft., showing vein 3 ft. wide of $30 ore. Crowding 5-stamp mill to capacity. Jim Blaine adjoins once famous Greenback mine on the south.

UTAH

Beaver County

LEONORA (Milford)—Work is being done at two points northeast of shaft. Zinc ore has been opened.

Juab County

MARCH SHIPMENTS from 30 Tintic properties amounted to 542 cars as compared to 496 in February, and 445 in January.

MAMMOTH (Mammoth)—March production was 66 cars.

CARISA (Robinson)—Irregular shipments made by lessees. Work is expected to be resumed shortly, on company account.

EAGLE & BLUE BELL (Eureka)—New electric hoist is working satisfactorily. New compressor will be ready soon.

OPOHONGO (Mammoth)—Settlement received for two cars copper ore shipped by lessees from 500- and 700-ft. levels.

CHIEF CONSOLIDATED (Eureka)—March shipments amounted to 138 cars. Lease and option taken on Nellie Shea, Nellie Shea No. 2, and Aggie Shea patented mining claims in North Tintic. Option is for $25,000, and to run three years.

DRAGON CONSOLIDATED (Silver City)—Development during 1915 totaled 2,615 ft. Considerable ore, a great deal of which is low-grade, was blocked out. Large quantities of iron ore blocked out, awaiting suitable contract for it. The production of siliceous ore during the year was 7,804 tons, which sold for $103,898. Year closed with $38,627 cash on hand.

Salt Lake County

OHIO COPPER (Bingham)—Mill at Lark, operated by General Exploration Co., handling 2,400 tons of ore daily. Lessees are now paying 32% royalty on a sliding scale basis calling for 10% on 16c. copper, and an additional 2% on each additional cent in the price of copper.

Summit County

BIG FOUR (Park City)—Repairs and improvements being made, which will increase capacity of mill.

ONTARIO (Park City)—Electric pumps are working satisfactorily, and ore is being hoisted from the 1,550 level.

Tooele County

BULLION COALITION (Stockton)—Body of silver-lead ore of shipping grade recently opened in Honorine mine.

BUFFALO (Ophir)—Drifting on 500 level following promising vein. About 45 tons ore taken out in development.

CANADA

British Columbia

GRANBY CON. (Anyox)—Hidden Creek smeltery about free from winter interference with operations. Agglomerator will start operation soon as normal water power secured. This will permit entire four furnaces to run full blast. With agglomerator, the management expects 4 lb. of copper per ton of flue dust to be secured at a very low cost. February production was 2,690,265 lb. copper, of which the Anyox output was 1,618,928 lb. and the balance from Grand Forks.

Ontario

SCHUMACHER (Schumacher)—Three veins cut in north drift at 600-ft. level.

PARAGON (Elk Lake)—Compressor ordered and operations will commence soon.

JAMIESON (Porcupine)—Shaft down 40 ft. in rock, showing visible gold large part of distance.

McIVER (Kirkland Lake)—Putting down shaft on company's Oakes claims, on vein showing free gold.

BUFFALO (Cobalt)—Reported that company has made important recoveries of quicksilver by new process.

SENECA SUPERIOR (Cobalt)—Last shipments of ore being made from mine preparatory to closing down, property being worked out.

KING EDWARD (Cobalt)—National Mines, Ltd., has leased property and let contract for sinking shaft from 530-ft. to 1,030-ft. level.

JUPITER (Porcupine)—Ground broken for tramway around Pearl Lake for ore transportation to McIntyre mill, for which 3,000 ft. of rails required.

McKINLEY-DARRAGH (Cobalt)—Annual report shows production of 1,107,815 oz. at cost per oz. of 28c.; net profits, $236,656; surplus, $280,299. Ore reserves at end of year were 1,871,280 oz., as against 2,132,820 oz. at close of previous year.

DOME LAKE (Porcupine)—Annual report showed receipts of $80,707 and expenditures $74,930. Mill treated 11,827 tons, average assay being $9.12, with an extraction of 79.93%. With alterations now in progress mill when completed will handle from 1,500 to 1,800 tons per month.

LA ROSE (Cobalt)—Annual report shows combined surplus of holding and operating companies is $937,490. Production of silver was 1,135,142 oz., having net value of $526,996; cost of production, 31.64c. per oz., and net profit was $230,662. The only high-grade ore in sight is small amount contained in pillars; mill ore reduced to about 10,000 tons.

DOME (Porcupine)—Central shaft is being raised from the 700- to 600-ft. levels. When finished another section to 800-ft. level will be started. Foundations being laid for installation of second of three Hardinge ball mills. Secondary crusher will be installed to reduce ore when it comes from underground crusher before delivery to ball mills.

SOUTH AMERICA

Chile

BRADEN (Rancagua)—March production was 5,406,000 lb. copper compared with 2,842,000 lb. February and 4,556,000 lb. January. Output March, 1915, was only 2,522,000 lb.

PERU

CERRO DE PASCO (Sewell)—Copper production for March, 6,300,000 lb.

CIA. MINERA DE SAYAPULLO (Sayapullo)—This copper-silver property optioned to A. J. Bennett of Backus & Johnston Co. of Casapalca. Mines are "inside" from Trujillo, about 60 mi. from railhead at Ascope, but at elevation of only about 6,000 ft. Small smelting plant is on property and anthracite at Huayday, 9 mi. distant.

ASIA

Chosen

ORIENTAL CONSOLIDATED (Unsan)—During January running time of 200 stamps was 29⅞ days; ore crushed, 26,806 tons.

The Market Report

Metal Markets

NEW YORK—Apr. 12

Very large business was done in copper and spelter and both those markets were exceedingly strong. Lead was relatively quiet.

Copper, Tin, Lead and Zinc

Copper—The outstanding feature of last week was the placing of enormous orders by the allied governments through their purchasing agent in New York. This business had been under negotiation for several weeks. The first order—for about 43,000 long tons—was consummated on Mar. 29. The purchaser had options on further quantities. One of these options—for about 40,000 long tons—was consumated on Apr. 7, and another one—for about 50,000 long tons—on Apr. 10. This business was shared by the two large producers, and being added to what had previously been sold by them, fills their order books pretty well for the remainder of this year. Anyway, the producers participating in this business are now insured high average prices for 1916. An order from another Government for 100,000,000 lb. is said to have been placed with other large producers. Agencies that did not participate in this huge business received some large independent orders from Europe.

At the same time extensive buying was done by domestic manufacturers, who became active after hearing of the immense governmental purchases, in fear that they might not be able to obtain copper needed for their business in the second half of 1916. Many of them were thus inspired to contract for copper in excess of the requirements of orders yet entered on their books. Others, however, especially those engaged in marginal business—like wire drawers and sheet rollers—hesitated to do that.

The bulk of the business done in the early part of the week was at 27½c., r. t., for near-by—meaning May and June—and 27c., r. t., for futures. In the latter part of the week the market rose to 28c., r. t., and 27½c., r. t., respectively. For spot and prompt delivery, fancy prices, such as 29@29½c., r. t., were reported realized. Such business was, however, of trifling volume, the major market now being for July and beyond.

Copper Sheets are firm and quotations are 34.50c. per lb. for hot rolled and 35.50c. for cold rolled. Usual extras charged and higher prices for small lots. Copper wire is 29¼@29¾c. per lb. in large lots.

Tin—This market was without features of special interest. Business in near-by was light, but there was good demand for forward deliveries. The tin business is terribly handicapped by the difficulty in obtaining permits for export from England. On Apr. 6 the local market was interested in a dispute between two interests with regard to alleged manipulation.

Lead—In some quarters a steady business in considerable aggregate volume was reported. A noteworthy feature was considered to be the appearance of a general demand for April and May shipment, to be taken at average prices. In other quarters the market was reported dull. Lead was offered right along in St. Louis at 7⅞@8c. In the latter half of the week some small sales were reported at 7¾c. Lead for August delivery was offered at 7¼c., and later at 7⅛c. At the present level of prices some producers let their quotations cover deliveries to all ordinary points, themselves absorbing the freight, so to speak.

Spelter—Very large business was done, both in brass special and in common spelter. In the main it was for export. The conditions of purchasing were similar to what prevailed in the case of copper, viz., certain producers obtaining most of the business. Some producers, meeting the general market, reported good demand for brass special, but very little for common spelter, domestic galvanizers not being buyers at all. The transactions were done in a great variety of ways, which makes it very difficult to quote the average market. The largest business was for April-September shipment. This was taken at a price lower than the average of the previous week, when business was done largely for first-quarter delivery. During the last week a large volume of business for delivery in the third quarter was taken at about 16@16¼c. There was also large business for the second half of the year at 14¼@14¾c. Business in spot and near-by was done at 18c. at the beginning of the week, and at 18¾c., in the latter part, but was relatively small in volume. The whole situation was at sixes and sevens, large sales for late delivery being made, with large demand; and on the other hand, there was but light demand for early spelter, with producers holding back, and consumers reporting themselves overbought and in some cases, desirous of reselling.

Zinc Sheets are in steady demand and sales have been good. The base price is unchanged at $25 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

DAILY PRICES OF METALS IN NEW YORK

Apr.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
6	4.7644	61¼	26¾ @27¼	53	7.50 @8.00	7.87½ @8.00	16.00 @18.00
7	4.7644	61⅛	26¾ @27¼	53	7.50 @8.00	7.87½ @8.00	16.00 @18.00
8	4.7644	61⅛	27 @27½	53	7.50 @8.00	7.87½ @8.00	16.00 @18.00
10	4.7644	62¼	27 @27½	53	7.50 @8.00	7.75 @8.00	16.00 @18.00
11	4.7644	62¼	27¼ @27½	53	7.50 @8.00	7.75 @8.00	16.00 @18.00
12	4.7644	62¼	27¼ @27½	53	7.50 @8.00	7.75 @8.00	16.00 @18.00

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are as reported by Handy & Harman and are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts per Lb
6	29 7/16	117	114	135	29.74	201	196	33	7.03	93	19.80
7	29⅜	118	115	134	29.53	202	196	33½	7.13	94	20.01
8	29 7/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	29 11/16	118½	116½	134	29.53	205	199	34	7.24	97	20.63
11	29 11/16	120	118	135	29.74	202	199¾	34½	7.30	98	20.84
12	29⅝	122½	119½	135	29.74	205¾	200	34⅝	7.40	100	21.29

The above table gives the closing quotations on London Metal Exchange, All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices. in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

Other Metals

NEW YORK—Apr. 12

Aluminum—The demand continues steady and the market is firm. Quotations are 59@61c. per lb. for No. 1 ingots, New York

Antimony—Market has been steady with fair business for spot and early deliveries at 43@44c. per lb. For Chinese, March-April shipment, the market has been quiet at 32@35c. per lb., c.i.f., N. Y., duty unpaid.

Quicksilver—There has been no recovery. Business is dull and prices are again lower. New York quotation is $135@140 per flask with light sales. San Francisco reports by telegraph $150 per flask, with business dull. In the East, stocks are larger than in the West and the selling pressure is considerable.

Nickel—Business is steady and prices unchanged. Ordinary forms are 45@50c. per lb., according to size and terms of order. Electrolytic nickel is 5c. per lb. higher.

Receipts at Baltimore for the week included 574 tons nickel matte from New Caledonia, by way of Sydney, Australia.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.25 per lb. New York. The London price is 11s. per lb.—**Cadmium** is quoted at $1.50 per lb. New York.

IMPORTS AND EXPORTS

Exports and Imports of Secondary Metallic Products in the United States, year ended Dec. 31, as reported by the Department of Commerce, in pounds:

	Exports		Imports	
	1914	1915	1914	1915
Copper sulphate	7,387,226	13,952,839	.....	.....
White lead	17,645,538	25,313,239	.....	.....
Zinc oxide	31,183,369	39,960,899	.....	.....
Zinc dust	350,262	431,815	4,604,107	1,712,373
Zinc dross	5,071,067	8,333,513	.....	.....

The exports of zinc dust reported are all reëxports of foreign material.

Gold, Silver and Platinum

NEW YORK—Apr. 12

Gold—The receipt of $1,060,000 in gold coin from Cuba is noted this week.

Exports of gold from New Zealand for the full year were 227,954 oz. in 1914, and 422,825 oz. in 1915; an increase of 194,871 oz. last year.

Exports and Imports of Gold and Silver in the United States two months ended Feb. 29, as reported by the Department of Commerce:

	Gold		Silver	
	1915	1916	1915	1916
Exports	$1,745,388	$23,898,184	$8,612,321	$9,578,573
Imports	19,622,890	21,024,238	4,686,078	4,447,366
Excess	I. $17,877,502	E. $2,873,946	E. $3,925,443	E. $5,131,207

Exports of merchandise in 1916 were valued at $740,628,914; imports, $378,297,234; excess of exports, $362,331,680. Adding gold and silver gives $370,338,833 as the total export balance.

Platinum—The market is dull with few sales reported, and prices are somewhat easier Sales of refined platinum are reported at $80@87 per oz. Hard metal is about $5 higher.

Silver—The market continues strong on buying for coinage for the English Mint and the Continent. ?

Supplies of silver are reduced and sellers not pressing, and in consequence buyers are advancing the bid price. Market closes strong in London at 29⅞d. and the tendency is favorable for higher prices.

Imports of Silver into the United States in January were valued by the Department of Commerce at $1,851,943; the largest item being $634,685 from Mexico, $515,594 from South America and $459,874 from Canada. Exports were $4,635,956, the largest item being $3,815,179 to Great Britain.

Silver exports from New Zealand for the full year were 590,162 oz. in 1914, and 957,541 oz. in 1915; an increase of 367,379 oz. last year.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Apr. 8

The base price paid this week for 60% zinc ore was $108@110 per ton. The base price paid for 80% lead ore was $95 per ton.

SHIPMENTS, WEEK ENDED APR. 8

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	4,054,000	148,700	707,500
Year	58,246,000	1,221,450	15,143,100

Shipped for week to separating plants, 5,296,000 lb. zinc ore.

JOPLIN, Mo.—Apr. 8

Blende, high price, $121.75; per ton 60% zinc, premium ore $115@120; medium grades $117@105, and lower grades as low as $100; calamine, per ton 40% zinc, $90@80; average selling price, all grades of zinc, $110.56 per ton. Lead, high price $104.45; per ton 80% metal contents $102@100; average selling price, all grades of lead, $100.19 per ton.

SHIPMENTS WEEK ENDED APR. 8

	Blende	Calamine	Lead	Values
Totals this week	17,298,280	1,238,690	2,302,750	$1,140,020
Totals this year	190,944,550	17,368,040	32,618,510	12,644,220

Blende value, the week, $973,450; 14 weeks, $10,569,700.

Calamine value, the week, $51,250; 14 weeks, $642,520.

Lead value, the week, $115,320; 14 weeks, $1,432,000.

The molders' strike was settled early this week and prevented a shortage of hard iron castings but the machinists are still out, asking for an 8-hr. day at 50c. per hour instead of a 9-hr. day at 40c. per hour. Beginning last Sunday this has been a busy week of buying for the agencies of several smelting companies. One buyer has out bids up to midnight tonight, and may continue buying tomorrow. It is being purchased for shipment over a period of three weeks, and while the buying was, perhaps, the heaviest known in one week, the shipments will be so distributed as not to disclose the full extent.

OTHER ORES

Antimony Ore—Market very quiet. Owing to high ocean rates and scarcity of carriers, sellers demand terms f.o.b. South American ports which buyers refuse to meet. For forward shipment price holds nominally at $2.60 per unit.

Tungsten Ore—The market is exceedingly firm and tungsten still in strong demand. There are no buyers for quantities above $80, though small quantities have changed hands at $85 per unit. The freight position with South America makes this business more difficult than before, and lately all offers from South America have been considerably increased on this account.

Manganese Ore imports in the United States in January are reported at 16,648 gross tons. Imports at Baltimore for the past week included 2,700 tons from Brazil.

Molybdenite, 80 to 90% MoS_2, is quoted at $1.40@1.50 per lb., according to size of order.

Pyrites—Receipts at Baltimore for the past week included 6,006 tons iron pyrites from Huelva, Spain.

Iron Trade Review

NEW YORK—Apr. 12

The streak of conservatism to which reference was made last week is only barely perceptible in the iron and steel markets, and activity continues to be the rule. Domestic business and demand seem to be as strong as ever, while export orders are pressing still more actively upon the market.

The United States Steel Corporation reports the total unfilled orders on its books Mar. 31 at 9,331,001 gross tons of material, an increase of 762,035 tons over Feb. 29. This is an increase of 5,075,257 tons over Mar. 31, 1915; and is 841,283 tons over Dec. 31, 1906, which was the maximum reported prior to February of this year.

Pig Iron Production in March shows further increase. Reports of the blast furnaces as collected and published by the "Iron Age" show that on Apr. 1 there were 317 coke and anthracite stacks in blast, having a total daily capacity of 108,500 tons; an increase of 1,000 tons over Mar. 1 Making allowance for the charcoal furnaces, the approximate production of pig iron in the United States in March was 3,372,900; for the three months ended Mar. 31 the total was 9,716,000 tons. Of this total 6,810,000 tons, or 70.1%, were made by the furnaces owned or operated by steel companies.

Exports and Imports of Iron and Steel, including machinery, in January are valued by the Department of Commerce as follows:

	1915	1916	Changes
Exports	$18,053,421	$51,643,807	I. $33,590,386
Imports	1,616,593	1,251,288	D. 365,305
Excess, exports	$16,436,828	$50,392,519	I. $33,955,691

The larger increases this year were in bar iron and steel, in rails, in sheets and plates and in wire.

Rail Production in the United States in 1915 is reported by the American Iron and Steel Association at 2,204,203 gross tons; which is 59,108 tons more than in 1914, but 1,298,577 tons less than in 1913. Of the rails reported in 1915, there were 1,775,160 tons—or 80.5%—rolled from openhearth steel, and 326,952 tons—or 14.9%—from bessemer steel. The remaining 102,120 tons were rolled from electric or other steel, or were rerolled from used rails.

PITTSBURGH—Apr. 11

The pace at which steel prices are advancing is distinctly less than that shown by the record in February and March, but the trends are still distinctly upward. The slower pace does not necessarily suggest that the advancing movement is nearing its end, but may as readily be interpreted as suggesting that the movement as a whole can last the longer.

Even the steel trade itself seems to be startled by the Steel Corporation's unfilled tonnage statement, made public yesterday, showing that there was during March an increase of 762,035 tons in unfilled obligations. Assuming that half the increase was in standard rails the bookings were still largely in excess of shipments, despite the high prices, and the month is yet to come in which the bookings will merely equal shipments. After that they could taper off for months before the accumulation of business would be worked off, for the 9,331,001 tons on books at the close of March, if evenly distributed as to character of material and time of delivery, would carry the Corporation for 7½ months, or to the middle of November.

April promises to be a heavy month for rail orders, for 1917, as notice has been served that the price of standard rails, unchanged since February, 1901, may be advanced after this month.

The New Haven embargo is practically lifted, and the situation on the Pennsylvania promises to improve steadily as cars destined for the New Haven, which have been blocking tracks for months, are moved over the transfer. Steel shipments to the East and New England will increase, and the scarcity in the Central West may thereby become more pronounced.

The steel industry is much more concerned over the labor supply this summer than over the continuance of the present steel demand. Weekly the situation is growing more threatening and already many men are employed at premium rates. A convincing illustration of the scarcity is the fact that furnaces which have piled pig iron against sales to middle interests cannot load the iron as fast as desired; all that stands in the way of their being paid for the iron is their inability to ship.

Pig Iron—The market is strong but far from active. Production has been unexpectedly large, and has just reached a rate of 40,000,000 tons a year, nearly 5,000,000 tons in excess of estimates of capacity made a year ago. Consumers generally appeared to have feared a shortage and have contracted freely from time to time, whereby the market is now quiet. Either of two contingencies, neither improbable, would cause a spectacular rise in prices, the entrance of some of the large steel interests into the merchant market, to supplement their own pig-iron production, or failure on the part of the furnaces to make deliveries according to contract. About half a dozen furnaces have gone out in the past fortnight for relining, in the East and Central West. We quote: Bessemer, $21@21.50; basic, malleable and foundry, $18.50@19; forge, $18@18.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Steel—The situation in the billet and sheet-bar market continues puzzling, for however high nominal prices go or however long the mills work at filling their old obligations the offerings in the market do not increase. Few if any of the mills will quote on soft steel for any delivery, and the offerings of middlemen are very limited. The chief activity is in steel rejected under war specifications, and while this steel is nearly always quite unsuitable in one respect or another it is picked up by customers who can get nothing else, at prices from $40 up. The fairest approximation for market quotations seems to be $45 for bessemer and $45 to $50 for openhearth billets and sheet bars. Forging billets are all of $65 while war steel billets run up to $80. Rods are about $60, with high-carbon rods $75 and higher. Deliveries on regular billet and sheet-bar contracts are fair.

FERROALLOYS

Ferromanganese—The majority of the large steel mills are carrying stocks of ferromanganese equal to their consumption for several months, and although their highest priced purchases for forward delivery are at $175 they are not tempted to sell any material even though $400 or higher would be bid for prompt carloads, there being too much high-priced steel business on books to warrant taking any risks.

Imports of ferromanganese in February are reported at 6,892 tons.

Ferrosilicon—The nominal quotation for 50% alloy is $83@85 per ton at furnace. This is mainly for second-half contracts, since material for early delivery is very scarce, and up to $95 has been paid for spot delivery.

Spiegeleisen, 20%, is quoted at $65 per ton for second half, while $105 has been paid for 30%. Premiums are reported paid for early delivery, which is not often available.

IRON ORE

First steps toward the movement of iron ore from the Lake Superior region are being taken. The first shipments will be from Escanaba, where navigation can generally be opened much earlier than through the Sault.

Shipments of ore from Port Henry, N. Y., have been much delayed by railroad embargoes. Lake Champlain and the canal are not yet open.

Imports and Exports of Iron Ore in the United States in January are reported by the Department of Commerce as below, in gross tons:

	1915	1916	Changes
Imports	75,286	89,844	I. 14,558
Exports	1,562	3,953	I. 2,391

The principal exports this year were 63,656 tons from Cuba, 11,050 tons from Spain, 7,001 tons from Sweden. Exports were chiefly to Canada.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier" at 476,995 net tons; shipments, 476,924 tons. Shipments of Greensburg and upper Connellsville districts, 47,967 tons.

Connellsville—The whole coke market has softened very visibly in the past week. First there came a decided increase in production, and then requests from various furnaces for suspension of one to two weeks in shipments against contracts, doubtless because the time for maintaining reserve stocks at the furnace had passed. In addition, five or six furnaces tributary to the Connellsville region have been blown out in the past fortnight. Spot furnace coke is down fully 50c. in the past fortnight. Additional sales of furnace coke for second half were made recently at $3, involving about 25,000 tons a month, divided into three or four contracts, and bringing the total second half business done on this movement up to about 50,000 tons a month; but with the recent weakening in the market buyers have lost interest. We quote: Spot furnace, $2.25@2.50; contract, $2.50@3; spot foundry, $3.75; contract, $3.50, per net ton at ovens.

Exports of Fuel from the United States, in January, in gross tons:

	1915	1916	Changes
Anthracite	190,299	274,986	I. 84,687
Bituminous	633,145	942,144	I. 308,999
Coke	57,447	90,890	I. 33,443
Bunker coal	528,418	570,461	I. 42,043
Total	1,409,309	1,878,481	I. 469,172

The bunker coal or coal furnished to steamships is practically all bituminous. The greater part of the exports is to Canada.

Coal Production of Spain year ended Dec. 31, in metric tons:

	1914	1915	Changes
Anthracite	228,302	252,483	I. 24,181
Bituminous	3,905,080	4,234,798	I. 329,718
Lignite	309,473	347,072	I. 37,599
Total	4,442,855	4,834,353	I. 391,49

The total increase in 1915, as compared with 1914 was 8.8%. The imports, however, showed a large decrease.

Chemicals

NEW YORK—Apr. 12

The general markets are fairly active. Business in heavy chemicals is steady and prices well maintained.

Arsenic—Business is fair and prices are steady. Sales are reported around $6.25 per 100 lb. for white arsenic.

Imports of arsenic into the United States in January were 199,618 lb., a decrease of 380,041 lb. from last year.

Copper Sulphate—Business here has been rather quiet and less inquiry for export is noted. Quotations are $20@21 per 100 lb. for carload lots and over.

Nitrate of Soda—Statistics are not favorable, and the market is easier at about $3.40 per 100 lb. for spot.

Shipments from the West Coast of South America, two months ended Feb. 29, in gross tons:

	1913	1914	1915
To United States	86,150	43,550	172,700
To Europe	323,200	137,350	284,600
Totals	409,350	180,900	457,300

Stocks on the West Coast on Mar. 1 are reported at 808,000 tons. Prices were 6s. 8d.@7s. per quintal for shipment.

Sulphur—Imports of sulphur into the United States in January were 2,321 gross tons, an increase of 1,911 tons over 1915. Exports were 10,116 tons, an increase of 9,952 tons. Imports of pyrites were 134,605 tons, an increase of 96.219 tons over last year.

Assessments

Company	Delinq.	Sale	Amt.
Adventure, Mich.	July 20		$0.50
Allah, Utah	Mar. 25	Apr. 15	0.0025
Benton, Ida.	Apr. 15	May 15	0.005
Caledonia Silver, Nev.	Apr. 7	Apr. 28	0.05
Demijohn, Nev.	Apr. 14	May 5	0.005
Dennemora, Ida.	Apr. 5	May 15	0.002
Diam'dfield Black Butte, Nev.	Apr. 12	May 18	0.01
East Hercules, Ida.	May 1	June 1	0.0015
Echo, Ida.	Apr. 14	May 15	0.002
Elise, Utah	Apr. 12	May 18	0.0025
Eureka Dev. Utah	Apr. 10	May 1	0.02
Federal Ely, Nev.	Apr. 1	May 1	0.005
Federal Ely. Nev.	May 1	June 4	0.005
Flagstaff, Ida.	Mar. 20	Apr. 15	0.002
Friend, Ida.	Apr. 28	May 20	0.002
Great Bend, Nev.	Apr. 5	May 8	0.01
Howell, Utah	Apr. 15	May 3	0.01
Idaho-Nevada, Ida.	Apr. 7	May 1	0.002
Index, Ida.	Apr. 6	May 6	0.0025
International, Ida.	Mar. 16	Apr. 10	0.002
Laclede, Ida.	Apr. 25	May 15	0.003
Mayflower, Ida.	Mar. 15	Apr. 15	0.005
National Copper, Ida.	Mar. 25	Apr. 22	0.01
Neva, Utah	Apr. 13	May 1	0.002
Nevada-Douglas	Apr. 17	May 16	0.10
Nevada Stewart, Ida.	Mar. 25	Apr. 14	0.002
North Bunker Hill, Ida.	Apr. 18	May 20	0.002
Park Gold, Utah	Apr. 1	Apr. 20	0.001
Republic, Utah	Apr. 22	May 13	0.005
Rhode Island, Ida.	Mar. 30	May 15	0.002
Rio Grand Grubstake, Nev.	Mar. 27	Apr. 22	0.006
Rockford, Ida.	Mar. 15	Apr. 15	0.001
Silver Mt., Ida.	Feb. 17	Apr. 15	0.002
Summit Ex., Utah	Mar. 15	May 1	0.01
Sunset, Nev.	Mar. 27	Apr. 29	0.01
Tiberius, Ida.	Apr. 15	May 15	0.001
Tonopah Bonanza, Nev.	Apr. 3	May 8	0.01
Tono. Gypsy Qn., Nev.	Mar. 20	Apr. 24	0.01
Umatilla, Nev.	Apr. 17	May 22	0.005
Utah-Arizona, Ariz.	Apr. 14	May 16	0.0025
Utah Con., Utah.	Apr. 22	May 13	0.005
Utah Metals, Utah	Mar. 11	Apr. 15	0.001
Wasatch, Utah	Apr. 3	May 8	0.01

Stock Quotations

SAN FRANCISCO Apr. 11	
Name of Comp.	Bid.
Alta	.04
Andes	.07
Best & Belcher	.05
Bullion	.01
Caledonia	.40
Challenge Con.	‡.05
Confidence	.15
Cons. Imperial	.01
Con. Virginia	.16
Gould & Curry	.02
Hale & Norcross	.03
Jacket-Cr. Pt.	.13
Mexican	.21
Occidental	.75
Ophir	.28
Overman	.04
Savage	.06
Seg Belcher	.02
Sierra Nevada	.23
Union Con.	.43
Utah Con.	.01
Belmont	4.60
Jim Butler	.93
MacNamara	.08
Midway	.23
Mont.-Tonopah	.27
North Star	.17
Rescue Eula	.36
West End Con.	.77
Atlanta	.13
Blue Bell	.02
Booth	.21
C.O.D. Con	.04
Comb. Frac	.07
D'field Daisy	.03
Jumbo Extension	.77
Pitts.-Silver Peak	.08
Round Mountain	.70
Sandstorm Kendall	.04
Silver Pick	.08
Central Eureka	.09
Argo	.46
Big Jim	1.97
Lazy Boy	.35
Oatman Cres	.40
Oatman No. Star	.23
Tom Reed	1.92
United Eastern	3.87½
United Western	.34

LONDON Mar. 21	
Alaska Tre'dwell	£6 12s 6d
Burma Corp.	1 15 0
Cam & Motor	0 11 3
Camp Bird	0 7 0
El Oro	0 8 0
Esperanza	0 10 0
Mexico Mines	3 15 0
Nechi, pfd.	0 14 0
Oroville	0 14 0
Santa Gert'dis.	0 10 6
Tomboy	1 1 6
Tough Oakes	0 11 3

SALT LAKE Apr. 10	
Name of Comp.	Bid.
Beck Tunnel	.22
Black Jack	.12
Colorado Mining	.20
Crown Point	.08½
Daly-Judge	7.40
Emma Cop.	.62
Gold Chain	.24
Grand Central	.77
Iron Blossom	2.32
Lower Mammoth	.06
May Day	.16½
Opohongo	.03
Prince Con.	1.35
Seven Troughs	.02
Silver King Coal'n	3.02½
Silver King Con.	2.87½
Sioux Con.	.19
Uncle Sam	.08
Yankee	.25

COLO. SPRINGS Apr. 11	
Acacia	.04
Cripple Cr'k Con.	.005
Doctor Jack Pot	.10½
Elkton Con.	.27
El Paso	.85
Findlay	.04½
Gold Dollar	‡.01
Gold Sovereign	.03½
Golden Cycle	2.20½
Isabella	.20½
Jack Pot	.06½
Jerry Johnson	.05
Mary McKinney	.38
Portland	1.77
Vindicator	2.49

TORONTO Apr. 11	
Bailey	.04
Chambers Ferland	.20
Coniagas	4.25
La Rose	.56½
Peterson Lake	.26
Right of Way	.03½
Seneca Superior	.40
T. & Hudson Bay	25.00
Temiskaming	.56
Trethewey	.20
Wettlaufer-Lor	.06
Dome Exten.	.39
Dome Lake	.26½
Foley O'Brien	.50
Hollinger	26.50
Imperial	.04
Jupiter	.20
McIntyre	.90
Porcu. Crown	.74
Preston E. D.	‡.04½
Vipond	.55
West Dome	.23

N. Y. EXCH. Apr. 11	
Name of Comp.	Clg.
Alaska Gold M.	20
Alaska Juneau	9⅝
Am.Sm.&Ref.,com	101⅛
Am. Sm. & Ref., pf.	112⅛
Am. Sm. Sec., pf. A	94⅜
Am. Sm. Sec., pf. B.	85½
Am. Zinc	95⅝
Anaconda	86⅜
Batopilas Min.	2½
Bethlehem Steel	475
Bethlehem Steel, pf.	135
Butte & Superior	96
Chile Cop.	23
Chino	55½
Colo. Fuel & Iron.	44⅜
Crucible Steel	92⅛
Dome Mines	24⅛
Federal M. & S.	19⅛
Federal M. & S., pf.	42
Great Nor., ore., ctf.	43½
Greene Cananea	49⅛
Guggen. Exp.	21⅛
Homestake	127
Inspiration Con.	46⅛
International Nickel	49½
Kennecott	57
Lackawanna Steel	75⅛
Miami Copper	38⅛
Nat'l Lead, com.	66⅛
National Lead, pf.	114
Nev. Consol.	17⅛
Ontario Min.	8½
Quicksilver	3⅛
Quicksilver, pf.	4
Ray Con.	24
Republic I&S, com.	51½
Republic I&S, pf.	109
Sloss-Sheffield	54½
Sloss-Sheffield, pf.	95
Tennessee Copper	52⅜
Utah Copper	82⅛
U. S. Steel, com.	85
U. S. Steel, pf.	117⅜
Va. Iron C. & C.	‡52

N. Y. CURB Apr. 11	
Alta Con.	.27
Beaver Con.	.37½
Buffalo Mines	1½
Butte & N. Y.	3½
Butte C. & Z.	8½
Can. Cop. Corpn.	1⅛
Cashboy	.08
Cerro de Pasco	38½
Con. Ariz. Sm.	1⅛
Con. Coppermines	1½
Con. Nev.-Utah	1/16
Dia. Black B.	.02
First Nat. Cop.	6½
Florence	.43
Goldfield Con.	.81
Goldfield Merger	.14½
Granite	.75
Hecla Min.	4 13/16
Howe Sound	6
Kerr Lake	4⅛
Magma	18
Majestic	.75
McKinley-Dar-Sa	.46
Mines of Am.	3½
Mother Lode	.35½
Nevada Hills	.18
New Utah Bingham	‡3
Nipissing Mines	7⅜
Oro	.04
Ray Hercules	4½
Rochester Mines	.68
St. Joseph Lead	16⅛
Stand'd Oil of N.J.	517
Standard S. L.	1⅛
Stewart	1/32
Success	.78
Tonopah	6 1/16
Tonopah Ex.	6 1/16
Tonopah Merger	‡.55
Tribullion	1 1/16
White Knob, pf.	‡1½
Yukon Gold	2

BOSTON EXCH Apr. 11	
Name of Comp.	Bid
Adventure	4⅛
Ahmeek	400⅛
Algomah	1½
Allouez	70⅛
Ariz. Com., ctfs.	8½
Bonanza	.35
Butte Alex. Scott	‡10½
Butte-Ballaklava	3½
Calumet & Ariz.	74½
Calumet & Hecla	552
Centennial	17
Copper Range	65½
Daly West	3½
East Butte	12⅛
Franklin	8½
Granby	89½
Hancock	15½
Hedley	20
Helvetia	.35
Indiana	4½
Island Cr'k, com.	53
Island Cr'k, pfd.	90½
Isle Royale	27½
Keweenaw	5½
Lake	17½
La Salle	4½
Mason Valley	3
Mass	13½
Mayflower	3⅜
Michigan	3½
Mohawk	99½
New Arcadian	7½
New Idria	15½
North Butte	29
North Lake	1
Ojibway	2½
Old Colony	3½
Old Dominion	70⅜
Osceola	94
Quincy	94
St. Mary's M. L.	71½
Santa Fe	2⅜
Shannon	9⅜
Shattuck-Ariz.	34½
So. Lake	8
So. Utah	.40
Superior	16½
Superior & Bost.	3⅜
Tamarack	53
Trinity	8⅜
Tuolumne	.30
U. S. Smelting	77½
U. S. Smelt'g, pf.	53½
Utah Apex	4⅜
Utah Con	14⅜
Utah Metal	10
Victoria	4
Winona	4⅜
Wolverine	58
Wyandot	2½

BOSTON CURB Apr. 11	
Bingham Mines	12⅛
Boston Ely	.62
Butte & Lon'n Dev.	.89
Calaveras	4⅛
Calumet-Corbin	.05
Chief Con.	1 1/16
Cortez	.75
Crown Reserve	.55
Davis-Daly	1 1/16
Eagle & Blue Bell	2⅛
Houghton Copper	2⅜
Iron Cap Cop., pf.	5½
Mexican Metals	.41
Mojave Tungsten	5⅛
Nat. Zinc & Lead	3⅜
Nevada-Douglas	1
New Baltic	3
New Cornelia	16
Ohio Copper	.16
Oneco	1
Raven Copper	.18
Rex Cons.	.19
Rilia	.90
United Verde Ext.	26⅛

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250		26.958	23.709	
May	58.175	49.915		26.704	23.570	
June	56.471	49.034		25.948	23.267	
July	54.678	47.519		25.219	22.597	
August	54.344	47.163		25.979	22.780	
September	53.290	48.680		24.260	23.591	
October	50.654	49.385		23.199	23.925	
November	49.082	51.714		22.703	25.094	
December	49.375	54.971		22.900	26.373	
Year	54.811	49.674		25.314	23.675	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.17
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811		75.096		*	
May	18.506		77.600		*	
June	19.477		82.574		95.333	
July	18.796		76.011		91.409	
Aug.	16.941		68.673		82.333	
Sept.	17.502		68.915		85.250	
Oct.	17.686		72.601		88.000	
Nov.	18.627		77.744		93.273	
Dec.	20.133		80.773		100.43	
Year	17.275		72.532			

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884		166.225	
May	38.790		162.675	
June	40.288		167.636	
July	37.423		167.080	
August	34.389		151.440	
September	33.125		152.625	
October	33.080		151.554	
November	39.224		167.670	
December	38.779		167.000	
Av. year	38.590		163.960	

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.240	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221		4.142		21.094	
May	4.274		4.182		20.347	
June	5.932		5.836		25.170	
July	5.659		5.531		24.611	
August	4.656		4.520		21.946	
September	4.610		4.490		23.151	
October	4.600		4.499		23.994	
November	5.155		5.078		26.278	
December	5.355		5.266		28.807	
Year	4.673		4.567		22.917	

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012		9.837		49.888	
May	14.781		14.610		68.100	
June	21.208		21.038		100.614	
July	19.026		18.856		97.250	
Aug.	12.781		12.611		67.786	
Sept.	13.440		13.270		67.841	
Oct.	12.800		12.596		66.536	
Nov.	15.962		15.792		88.409	
Dec.	15.391		15.221		89.400	
Year	13.230		13.054		67.553	

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported

PIG IRON IN PITTSBURGH

Month	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55		13.45		13.95	
May	14.61		13.60		13.83	
June	14.70		13.67		13.77	
July	14.94		13.91		13.68	
August	16.01		15.31		14.75	
September	16.86		15.95		15.70	
October	16.95		15.96		15.80	
November	17.57		16.47		17.20	
December	19.97		18.44		18.95	
Year	$15.82		$14.76		$14.95	

‡As reported by W. P. Snyder & Co.